Science Education

SPECIAL ISSUE ON ELEMENTARY SCIENCE*

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SOME POINTS TO BE CONSIDERED IN TEACHING ELEMENTARY SCIENCE

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Elementary science is in its formative stages and is likely to remain so for many years to come. This situation is a most fortunate one. To be maintained in a state in which it is constantly undergoing modification in the light of research, experience, and competent opinion is a salutary and healthful condition for any part of the program of studies. It is true, of course, that mere change does not necessarily constitute improvement; innovations may prove regressive rather than progressive. Nevertheless the hope for continued and substantial improvement of any phase of education depends on its maintenance in a state of flux. For elementary science to be in this situation gives grounds for hope that in its development the more undesirable characteristics of courses of science as presented in the junior and the senior high schools can be avoided. A few of these characteristics seems especially worthy of discussion.

THE TEACHING OF FACTS AS ENDS IN THEMSELVES

It is unfortunately true that the chief objective of many courses of science, whether acknowledged or not, is the teaching of factual information. Often, the success of the teacher is measured by the ability of the pupils at the conclusion of the work to score well in tests covering the factual information believed to be appropriate to the course. It is not surprising that the fact-teaching aim is frequently the dominant one. The factual information possessed by pupils at the time the examination is administered, is the factor most easily, conveniently and objectively measured. That pupils forget such factual information with astonishing celerity and completeness is often ignored.

There is an opportunity in directing the development of elementary science to avoid this unfruitful objective which dominates so much of the teaching of science at the

** Editor's Note.—The National Council on Elementary Science has chosen this year the March issue as their special number. The articles and classroom notes have been prepared by the Editorial Committee named above. We trust that this issue will prove to be even more interesting and valuable than the January number of last year prepared by the N.C.E.S. group.*

junior- and the senior-high-school levels. The way is open to recognize from the start that, whether the work be presented as a separate course or as one of the elements of an activity program, facts should be selected and presented only as a means of effecting more important and more enduring outcomes than the subsequent recall of these facts. The major objectives thus furthered would probably include these four:

(1) To effect a functional understanding of important generalized statements, or principles of science. *The Thirty-first Yearbook* [1] stresses this objective of science teaching and gives valuable suggestions concerning its realization. Recent research by Tyler [2] and by others, moreover, indicates clearly the ephemeral nature of a knowledge of facts as compared with a knowledge of principles of science. Fortunately, also, Robertson [3] has made available an invaluable list of scientific principles suitable as the basis for instruction in science at the elementary-school level.

(2) To insure a facility in the use of the elements of scientific method in solving problems. The recent report of the Committee of Science of the Progressive Education Association gives excellent and abundant materials designed to further this objective.[4]

(3) To afford a training designed to develop scientific attitudes, with special emphasis upon their social implications and applications. A list of these attitudes is provided in the Thirty-first Yearbook.[5]

(4) To insure a realization of the appropriateness and the potential values of activities related to science in leisure pursuits and hobbies.

Recently there have been some curious attempts to justify the teaching of the facts of science merely as ends in themselves. Some vigorous and militant support of the thesis that only factual information should be taught in courses of science designed for pupils of limited ability has been advanced. In sporadic instances the statement has even been made that dull-normal pupils are incapable of reflective thinking, and that consequently in materials designed for them only factual information should be stressed. Educational psychologists, however, have presented abundant evidence indicating the basic fallacy in this thesis. They have demonstrated conclusively that differences between the very dull and the very bright are merely relative; that is, that they are differences in degree rather than in kind. Therefore, in organizing the work in elementary science we are justified in assuming that the dull-normal pupils in the group can acquire some facility in the use of factual information as a basis for solving problems, comprehending principles (generalized statements), and engaging in all other aspects of reflective thinking. They will, of course, require more time than the brighter pupils in order to attain these goals. They must progress by shorter, more numerous steps, and will finally attain the desired outcomes to a lesser degree than the intellectually superior children.

Occasionally one notes evidence of another fallacy with respect to learning which has a marked bearing on elementary science. This fallacy is embodied in a statement, or a tacit assumption, that children, especially those of the lower grades, are too immature to be capable of reflective thinking, and that, therefore, the teaching of factual information must of necessity be the primary aim in courses of elementary science. Such statements and assumptions are apparently based on the long-since-exploded psychological theory of saltatory development. Fortunately data relative to this question and specific to instruction in science are available. Croxton [6] has pre-

[1] Thirty-first Yearbook, National Society for the Study of Education, Part I. "A Program for Science Teaching." Bloomington, Illinois: Public School Publishing Company, 1932. Chapters I–V, and XII.

[2] R. W. Tyler. "What High-School Pupils Forget." *Educational Research Bulletin*, Ohio State University, IX (November 19, 1930), 490–92.

[3] Martin L. Robertson. "The Selection of Science Principles Suitable as Goals of Instruction in Elementary Science." *Science Education* 19: 1–4, 65–70; February, April, 1935.

[4] *Science in General Education.* New York: D. Appleton-Century Company, 1938.

[5] *Ibid.*, 56–57.

[6] W. C. Croxton. "Pupils' Ability to Generalize." *School Science and Mathematics* 36: 627–634; June, 1936.

sented impressive evidence to the effect that the ability to generalize and hence the ability to develop an understanding of principles, is possessed by children at all levels of maturity from the kindergarten through the grades and the junior high school.

A DISPROPORTIONATE USE OF DEDUCTIVE METHODS OF TEACHING SCIENCE

Even with the attention fixed upon the objective of using facts as a vehicle for effecting an understanding of principles, there is nevertheless the danger that teachers will use the deductive method exclusively in teaching principles. By this method the procedures lead from the general to the specific. Thus the principle is stated ready-made for the pupils, and their understanding of it is then developed through the introduction of applications and illustrations of the principle. At its worst, such teaching consists in having the pupils memorize the statements of principles with little effort on the teacher's part to insure that the pupils really understand the statements. The ability of the pupils subsequently to recite the statements of principles as "memory gems" is accepted by the teacher as satisfactory evidence of achievement. The teaching of principles wholly or chiefly by deductive methods is most commonly observed in classes of physics, and to a lesser though nevertheless pronounced extent, in classes of general science, chemistry, and biology. The following example will serve to illustrate how a principle is taught solely by deductive methods in a class in physics:

Let us suppose that the teacher desires the pupils to understand this minor principle which constitutes part of the major principle known as Boyle's Law: "When the pressure of a confined volume of air is decreased, the pressure of the air is increased." In developing this principle deductively, the teacher starts with a statement of the principle. This statement is then carefully explained, and several illustrations and applications of it are introduced by means of the air pump or more commonly, by a discussion of familiar examples or applications of the principle in daily life. As a result, if the teaching has been thorough and skillful, the pupils may be expected to arrive at a comprehension of the principle.

Such teaching as this, however, is contrary to the ways in which scientists have solved the problems of science since the earliest beginnings of problem-solving. Scientists and all others who have used the methods of science have attacked problems inductively; that is, from specific to general—from facts to principles. They have begun by attacking a problem the answer to which they did not already know, they have gathered facts pertinent to the problem, and finally, when they have gathered enough facts, they have formulated a generalized statement or principle which includes all these facts.

The following example will illustrate how the combined inductive-deductive methods might be used in teaching this same principle as that discussed previously, to a class of intermediate-grade children. The work may start with a problem somewhat like this: "Does the air in a rubber balloon press harder or less hard on the inside of the balloon when the balloon is made littler?" The children inflate balloons and squeeze them with the result that the balloons burst. With this first problem or question answered the pupils are ready for another such as this, "Does air that is compressed (that is, air that is pressed together) in a bicycle pump push harder or less hard than it did before it was compressed?" With a hand tire-pump, the children arrive at the answer to this problem by holding the end of the rubber tube leading from the pump, as the handle of the pump is pressed down, and as it consequently makes the volume within the pump less. From these and other facts learned from the solutions of problems similar to and closely related to the two already solved, the children are finally able to gen-

eralize; that is, they are able to make the statement of the minor principle somewhat like this, "When something that is full of air is pressed or squeezed so that it is made smaller, the air in it presses harder than it did before." They have arrived at this statement inductively—they have started with related problems and by solving these one by one they have secured enough facts to reveal to them the generalized statement. Thus they have proceeded from the particular to the general.

Having thus developed a comprehension of the principle inductively, the boys and girls are ready to develop a further understanding of it deductively; that is, by proceeding from the general to the particular. Thus they start with the principle and apply it in new situations. The work may follow some such lines as these: The children are given a problem like this, "What do you think might happen to an automobile tire full of air if the automobile were suddenly to run into the curb or into a large stone in the road?" In guiding the pupils to a solution of this problem the teacher will probably need to break it up into smaller problems. The extent to which the problem is thus made into smaller ones will of course depend on the maturity and ability of the group. Appropriate smaller problems might include these: "Would the tire be made bigger or littler by running into the curb?" "What would happen to the air in it when the tire was dented by the curb?" "Would the compressed air push harder or less hard inside the tire than it did before the tire was dented by the curb?" "What then might happen to the tire?" Progress through a series of problems such as these will lead the class to arrive at the conclusion, stated in terms of their own vocabularies and experiences, that the volume of the tire would be made less and consequently the pressure would be increased to a degree which might result in a blowout. Many other applications of this principle (that is, many other ways to make it clearer to the pupils by the use of the deductive method) will occur to every teacher—such examples as the reason that a rubber ball bounces, that a football can be kicked long distances, and the like.

It will be noted from these illustrations that both the inductive and the deductive method have important uses in problem solving and reflective thinking, but that induction should in most cases precede deduction. Thus, by the inductive method facts gathered in the solution of definite new problems are combined into generalizations, statements, or principles; then by the deductive method, the principles are applied in specific real-life situations.

HIGHLY FORMALIZED LABORATORY WORK

It is probably axiomatic to state that the performing of experiments is an appropriate and necessary part of work in science at any level. Complex equipment for such experimentation is not, of course, necessary for carrying on this part of the work. In elementary science the laboratory work and the equipment for performing it are expected to be simple. The term "laboratory work" is here meant to include any sort of activity, inside or outside the school room, in connection with which experiments are performed or observations of natural processes are made.

The purpose for which the experiments are performed is a consideration of paramount importance. Strangely enough the principal aim of much, if not most laboratory work at the senior-high-school level is the verification of facts or principles already learned. The method used with such laboratory work is almost universally the deductive method. The pupil goes into the laboratory to verify some facts or perhaps a principle which he has already studied to the extent that he has gained at least a fair degree of understanding of it. The experiments are performed usually on certain days, often in special rooms set aside for laboratory purposes, and following class discussion of the topics to which the ex-

periments are related. As a result of such formalized and artificial conditions, it is inevitable that the laboratory work constitutes what is essentially a separate course from the rest of the work which is based on the textbook, classroom discussions, and the like; close integration of the laboratory work and other phases of the course is rendered impossible because of the restrictions imposed by the special schedule for experimenting in the laboratory. Furthermore, such a program fails to render what is perhaps the most important function of experimenting; namely, to serve as a means by which the pupils find the answers to questions when these answers are as yet unknown to them.

Let us hope that these relatively ineffective practices will be avoided in elementary science at all levels. Support is rapidly growing for the thesis that laboratory work at the elementary-science level (and at the junior- and senior-high-school levels also) serves its purposes best when it is used to discover truth, not to verify truths already known. If this thesis be accepted, then there can be no set time for experimentation or for observation in any elementary science class. Manipulations of materials are made, experiments are performed, and observations of natural processes are made at whatever time during the class period or during out-of-class activities when they will help to provide the answer to some problem that has arisen in the pupil's mind. They are made an integral part of the activities in hand; they are not allowed to become separate activities divorced from the rest of the work. Perhaps several successive periods may be profitably devoted to experimentation and observation in pupil attempts to solve one great problem or one series of problems; or perhaps all the experimentation which the pupils may do in a week or more may be accomplished in a part of one class hour. Furthermore, in general no pupil and no group of pupils would perform an experiment if he or they knew already what the outcome of the experiment or the observation should be. The purpose of the laboratory work would be to satisfy intellectual curiosity. Laboratory work of whatever kind might be appropriate to the activities at hand, would therefore precede study of the material covering the answer in textbooks or other sources. These latter would be used as a means of supplementing and revising conclusions and results tentatively arrived at as a result of experimenting. In other words, the relative positions of laboratory work and study of the topics to which the laboratory work is intended to contribute would be the reverse of that now found in most of the conventional courses in senior-high-school science.

It is to be hoped that elementary science, in its lusty growth, will be guided away from the grooves which conservatism and inertia have dug deep. It is inevitable that practices widely followed in connection with courses in the junior and senior high school will exert powerful influences upon elementary science in its formative stages. Such practices as those just discussed—namely, the teaching of facts as ends in themselves, the use of deductive teaching in place of a combination of inductive and deductive methods, and the formalizing of laboratory work—may readily be transferred to the work of elementary science and become a fixed part of it, particularly of the work of the intermediate grades. Only vigilance on the part of those directing the development of elementary science can prevent the incorporation of these and other undesirable practices into the elementary-science classes.

CONSERVATION STUDY

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One of the goals of science education in the elementary schools may well be the conservation of our natural resources. The teaching of conservation has not yet become an established part of the curriculum in New Jersey, but definite encouragement is being given to teachers to incorporate conservation material in their teaching programs. An organization cooperating with the State Department of Public Instruction is the New Jersey State Conservation Committee under the auspices of the Garden Club of New Jersey, the Garden Club of America, and the Garden Department of the New Jersey State Federation of Women's Clubs. This committee issues a 16-page manual on some phase of conservation to the schools annually. The manual is distributed by the Department of Public Instruction. The manual opens with a proclamation by the Governor designating the second week in April, which includes Arbor Day, as Conservation Week. A foreword by the Commissioner of Education gives proper educational sanction to the material.

Eight such manuals have been presented. For the last four years it has been the privilege of Mr. Shoemaker and myself to prepare the material for these manuals. We have worked on the premise that a knowledge of the things to be conserved is fundamental to the conservation of these things. The conservation of anything involves its recognition, its place in the natural order, and its relationship to man. The material must relate definitely to the immediate school environment. From an appreciation of problems in the school and community life the horizon of pupils widens in scope to include problems of the state, the nation, and the world. Suggestions for pupil activities are included under each phase. It has been customary to apportion the material under definite days of the week from Monday to Friday, ending on that day with suggestions for appropriate Arbor Day activities. Naturally, however, there is a tendency to use the material over the various seasons of the year, so as an experiment in 1940 this procedure has been set aside. Carefully selected references direct the teacher to materials which can be used to amplify the limited material of the manual. Lists of national, state and local organizations which are interested in conservation and from which material can be obtained are given. Along with the definite source material given any material presented along the line of conservation must have a definite appeal, an accompanying inspirational stimulus which brings about an urge in the individual "to do something about it." Definite information on what one can do about it is included in the manual.

It is interesting to note that the National Wildlife Federation has appointed a committee on Education in Conservation. One of the problems before this group is the kinds of materials to be furnished teachers and prospective teachers to enable them to teach conservation of our natural resources effectively. Information of this kind will be welcomed by all of us who deal with the training of teachers for the public schools. Meanwhile as far as the conservation of wildlife is concerned, we use whatever material is available. The Cornell Rural Leaflets offer an example of instructional material conducive to success in this field.

In the early part of the twentieth century State Museum reports on the animals and plants of New Jersey were issued. Since then so far as can be learned there is little material available in a form easily usable

by teachers. The manuals on native plants, trees, birds and mammals of New Jersey are intended to fill this need for actual factual information in the small space available in a publication limited to 16 pages. We have endeavored to maintain scientific accuracy in any lists given and have had the lists checked by authorities. Since only a few of these bulletins are available for outside distribution because of limited funds, with the permission of the Conservation Committee a few pages from the various manuals are included here to illustrate the type of material which seems to be effective in use by teachers.

THE PRESERVATION OF NATIVE PLANTS *

"There is a delight in the hardy life of the open.
There are no words that can tell the hidden spirit of the wilderness, that can reveal its mystery, its melancholy and its charm.
The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased, and not impaired in value.
Conservation means development as much as it does protection."

(THEODORE ROOSEVELT—Inscription on the walls of the Memorial Hall of the New York State Roosevelt Memorial.)

The Flora of New Jersey Is Rich and Varied.—The flora of New Jersey has always been wonderfully rich and varied. In the north many plants common to the New England area are found, but in the south along the Coastal Plain the flora has been likened to a bit of the Southern States transplanted northward. In fact, the Coastal Plain flora of New Jersey is reckoned as one of the most interesting botanical areas in the United States, since it includes a region many parts of which are still almost primeval—the Pine-Barrens of New Jersey.

A study of the geographic areas of New Jersey helps in understanding the variety of plant life. There are three broad geographic areas: the Appalachian and the Highland areas composing mountainous ridges and long narrow valleys of the north and northwesterly part of the State; the Piedmont belt extending diagonally across the State southwest and northwest from the Delaware to the Hudson; and the Coastal plain, which includes all of the State south of a line drawn roughly from Newark to Trenton. In the north and the west of the State the land rises to a height of over 1,800 feet at High Point in the Kittatinny Ridge, and grades towards the south and east to low areas, many of them less than 100 feet above sea level. This difference in elevation gives a wide range of temperature, one factor in explaining the variety of plants in the State.

The composition of the different areas also influences the plant life. In the Appalachian Plateau and the Highlands, the soil consists of much limestone accompanied by iron and peat, and of glacial drift brought by the ice sheet of the glacial epoch. The southern limits of the glacial area run irregularly from Perth Amboy at the mouth of the Raritan River to Belvidere on the Delaware River.

Ferns are typical of this northern area and are found in greater number than in either the Piedmont or the Coastal Plain. A trip to Stokes State Forest or to Hacklebarney State Park at every season of the year would soon familiarize one with the plants of the area. In the forests and fields of this area typical plants are hepatica and bloodroot, the May-apple, false Solomon's seal and true Solomon's seal, Jack-in-the-pulpit, columbine, the trilliums, lady's slippers, Mertensia, and the closed and fringed gentians.

The Piedmont area is covered with marl and clay deposits and loam impregnated with iron. The plants of this region are for the most part similar to those of the northern area, only the number is fewer.

The striking difference in the plants of New Jersey occurs in the flora of the Coastal Plain, which has plants not found in any other section of the State. The Coastal Plain is covered with deposits of loose sand and gravel. The Pine-Barren area has been know in botanical circles for over one hundred years as one of the most interesting collecting regions in the United States. The accounts of trips of famous botanists of the nineteenth century through this region make fascinating reading in the Report of the New Jersey State Museum in 1910.

Whereas in the northern swamps the red maple is the typical tree and in the Piedmont the pin oak, in the Coastal Plain the white cedar is typical. Swamp magnolia, laurel and holly make the Coastal Plain woods green at all seasons. Sweet fern, huckleberry, blueberry, cranberry and bayberry are characteristic shrubs of the region. Improvement of the blueberry and the cranberry have made them important crops into the production of which much swampland has been diverted in New Jersey. It is still possible to drive along the main highways bordered by swamps glorious with golden club, to find Arethusa, turkey's beard, pitcher-plants, sundew, and orchids within a stone's throw of the road. The vast stretches of sandy spaces under the pines of the Barrens *(Pinus rigida)* where fire devastates areas almost annually have as their emblem of spring patches of white starry pyxie *(Pyxidanthera barbulata)*. The Pine-Barren heather *(Hudsonia ericoides)* makes golden patches on the white sand of the Pine-Barrens in the spring while its relative, the Beach heather *(Hudsonia tomentosa)*, forms white woolly patches, with yellow blossoms on the sand dunes of the Jersey Coast. The brilliance of the

* Reprinted from *The Preservation of Native Plants*, April 5–9, 1937.

Pine-Barren gentians *(Gentiana porphyrio)* vies in beauty with the gentians of the northern regions. The little grasslike fern *(Schizaea pusilla)*, or curly grass, is probably the most famous, the rarest and the least known of New Jersey ferns. The ground pine of the Pine-Barrens *(Lycopodium alopecuroides)* is in the same danger of extinction as its northern relatives.

Another factor causing differences in plants throughout the State is the migration of species. The Delaware River on the western border brings seeds to New Jersey from New York State and Pennsylvania. The Hudson River and the Atlantic Ocean on the eastern shores bring in seeds of many lands to the Coastal Plains of New Jersey. Air currents undoubtedly plays their share also in the distribution of seeds from one region to another.

To Pick Wisely One Must Know How Plants Reproduce.—Plants make more of their own kind invariably, and a knowledge of these methods of reproduction is essential in picking flowers.

Some plants, such as Solomon's seal, arbutus and Dutchman's breeches, have underground stems or so-called rootstocks. When the soil is carefully removed from these plants they will be found to have divided many times, each division establishing itself as an independent plant oftentimes. Mandrake, ground pine, many ferns, golden-rods, asters, daisies, grasses, sedges, and many common weeds of the open field, spread in this same way. Food is manufactured in the leaves and stored in these underground rootstocks so that the plant can make an early start in the following season. This accounts for the early blossom of hepatica, bloodroot, arbutus, and pyxie in early spring before the seeds of plants have found conditions favorable for germination.

If the plant is pulled up carelessly, rootstock and all, when in flower, it may suffer extermination: that is the gradual fate of the trailing arbutus.

The trillium has a perennial root which lives on from year to year. The three leaves of the trillium are borne in a whorl on the upper part of the stem near the flower, and are usually picked with the flower. This weakens the root in that the leaves which manufacture the food for the growth of the root are removed before they have had time to function and probably this trillium plant may never again produce a flowering plant.

Some plants reproduce from a bulb. A swamp orchid of the Coastal Plain, Arethusa, has a bulb almost on top of the moss, and it is usually pulled up when picking the flower. This has made Arethusa rare in Coastal Plain swamps. Jack-in-the-pulpit, sometimes called Indian turnip, has a corm underground.

Plants also reproduce by the union of male and female sex cells to form seeds, each of which under favorable conditions of soil and climate grows into a plant like the parent plant.

The violet is usually cited as a plant which may be picked without harm because it has several methods of reproduction. It has a perennial root which lives on from season to season, and produces new leaves and flowers each year. It produces numbers of leaves separate from the flower stems, so that there are always plenty of leaves to support the root. In addition to the violet flowers prized by all are inconspicuous flower buds known as cleistogamous flowers which are self-fertilized in the bud to produce seeds. By the scattering of seed from these unattractive flower buds which are never picked, large numbers of violet flower plants are produced.

Still another means of reproduction is by special one-celled bits of matter called spores. The ground pine reproduces by spores; ferns bear spores either in the fronds or on special separate stalks.

Draw an outline map of New Jersey, mark the geographcial divisions as well as you can, and locate your community on the map. Study the list of wild flowers given on page 7 of this manual; how many are living in the wild in your community?

Write in the names on your map, or sketch them. Can you find some way to indicate their environment?

In studying methods of plant reproduction, use cultivated plants or those which are listed to be picked freely.

*Field Study Is the Way to Learn Trees.**—In studying trees the characters to note are leaves, flowers, fruits, bark, buds, bud arrangement, leaf scars and tree habit. While the leaves form the easiest guide to tree study, they are lacking on the deciduous trees of New Jersey for six months of the year; so that during the winter season the unvarying characters of buds and leaf scars, together with bark and general shape, form the only reliable guides. Some trees can be easily distinguished by form, although conditions of climate, of light, wind and moisture may influence the shape of a tree.

The woodsman recognizes trees by the bark more than by any other character. The peeling white bark of the paper birch, the smooth gray bark of the American beech, are easy to remember. Bark varies in appearance with the age of trees and is difficult to describe accurately in all cases, however, so it cannot be used as an infallible guide to identification.

The flowers of the fruit trees, the dogwood, and the laurel enable many to identify them in the spring but unless additional characters are known at other seasons, the trees may not be recognized. Professor Walter E. Rogers was inspired to produce his unusual book containing beautiful photographs of tree flowers and sketches of trees in winter form because he felt that most people do not consider our common trees as higher flowering plants and do not appreciate trees as a vital part of the winter landscape. Most of us

* Reprinted from *The Conservation of Trees and Forests*, April 4–8, 1938.

have our eyes not far from the ground unless we are trained to look up.

The fleshy fruits of apples, of cherries, and the nuts on oaks and hickories help in the recognition of these trees when they are bearing.

Leaves are widely studied as a means of identification when present. For the recognition of needle-leaved evergreens the number of leaves in a cluster and the length, shape and markings of the leaf are distinctive for the various species. Some leaves, like the palmately compound leaf of the horse-chestnut and the glove form of the sassafras are easily recognized, but confusion may exist for the beginner between leaves such as those of maple, tulip tree and sycamore. Distinction between the varieties of oaks and maples can be made only by a combined study of leaves and fruit and bark.

It is obvious that a number of characters must be used in learning to know trees. It is also obvious that the only way in which to gain an appreciation and understanding of the tree as an individual and the forest as an association of individuals is by outdoor study.

Study trees and keep a list of the trees you know by flowers, fruit, bark, leaves. Photograph trees, and make closeups of the trunk. Make leaf prints, press leaves, draw leaves, paint leaves, allowing pupils to express their interest in various forms of activity. Study leaves according to leaf margins, as to type of venation. Visit trees at all seasons, examining buds, flowers, seeds and fruits. Draw twigs of evergreens; mounted specimens will last but a few days since the needles drop soon.

Birds Can Be Attracted to Our Communities.—Birds can be attracted to our homes, schools and communities by the special provision of food, water and nesting places. At all times of the year, but especially in winter when natural food is scarce, special tidbits can be put out.

The insectivorous birds such as the woodpeckers, nuthatches, chickadees, kinglets, creepers and jays will relish beef suet, meat scraps, all kinds of nuts, raw peanuts or peanut butter, sunflower seed, pancakes and doughnuts. The seed-eating birds such as the juncos, tree sparrows, song sparrows, purple finches, cardinals and grosbeaks like all kinds of seeds. Sunflower seeds are attractive to the chickadees, nuthatches, cardinals, goldfinches; hemp, millet, "chick feed," to juncos, sparrows, goldfinches; coarsely ground peanuts to chickadees, nuthatches, cardinals, tufted titmice, bluejays; and greasy crumbs to both the latter groups. A plan for a feeding shelter is given on page 13 of the manual. Consult Hausmann's *Attracting Winter Birds to the Home*, and U. S. Department of Agriculture Farmer's Bulletin No. 621 for further detailed information on the feeding of birds and the construction of feeding stations.

Survey your home and school grounds to determine what types of bird breeding stations could be used, then make various kinds and set them up.

It is also possible to grow natural food plants and let the birds reap the harvest as they please. Plants which can be cultivated in gardens to attract seed-eating birds are centaureas, columbine, prince's feather, echinops, gaillardia, pyrethrum, cosmos, love-lies-bleeding, asters, blessed thistle, California poppies, sunflowers small and large, coreopsis, marigold, tarweed, forget-me-not, portulaca. Various kinds of millet, sorghum, canary and other grasses are also relished by seed-eating birds.

Study the seed catalogues, and the space available for garden flowers at home and at school and plan to plant seeds which will produce food for birds. During the summer always allow some flowers to seed, and in the autumn when cleaning up the garden leave the stalks with seeds until the birds have finished their feast. Hummingbirds are said to prefer red flowers for nectar. What flowers could you plant to attract this small visitor?

Trees which provide seeds for birds are the cones of alders and birches, much sought after by redpolls, siskins, and goldfinches. The winged fruits of ash trees and boxelders are opened and the seeds eaten by pine and evening grosbeaks whose visits to the community are generally regulated by the supply of this type of food. The seeds of pine, larches, and other conifers are attractive to bobwhites, crossbills, grosbeaks and many others.

Fruit-eating birds are best served by planting selected species of fruit-bearing shrubs and trees. They should be such that not only will fruit be available throughout the late spring, summer and fall, but of kinds with fruits that persist until late winter and early spring, seasons of actual scarcity of bird foods.

The best wild plants are junipers, mulberry, bayberries, spicebush, thorn apples, and related fruits, sour gum, holly, elderberry, snowberry, honeysuckle, mountain ash, hawthorn, Virginia creeper, sumach (non-poisonous species).

Some fruit-bearing trees which are recommended by nurseries as attractive to birds for food and cover are flowering dogwood *(Cornus florida)*, hawthorn *(Crataegus oxycantha)*, American holly, Cucumber tree *(Magnolia acuminata)*, flowering crabapples *(Malus baccata, M. coronaria, M. floribunda, M. scheideckeri)*, bird and black cherry *(Prunus avium* and *P. serotina)*, Amercian and European mountain ash.

Shrubs of value are chokeberry *(Aronia arbutifolia* and *A. melanocarpa)*, Japanese barberry, purple Callicarpa, dogwoods *(Cornus alba sibirica, C. racemosa, C. stolonifera* and others), cotoneasters, scarlet-fruited hawthorn *(Crataegus coccinea)*, euonymous, Japanese holly, inkberry, and common winterberry *(Ilex verticillata)*, privet *(Ligustrum amurense, L. Ibota, L. ovalifolium)*, honeysuckles *(Lonicera latifolia, L. Morrowi, L. tatarica)*, hollyleaved Mahonia, glossy buckthorn, bush and climbing roses of various kinds including *Rosa rugosa*, European elder, Japanese snowball *(Styrax japonica)*, common snowberry and coralberry *(Symphoricarpos racemos* and *S. vulgaris)*,

high-bush blueberry, many viburnums including high-bush cranberry and European cranberry, maple-leaved viburnum, arrowwood.

Some vines recommended are bower vine *(Actinidia arguta* and *A. polygama)*, various ivies *(Ampelopsis heterophylla)* and *A. quinquefolia* (Virgina creeper), *A veitchi* (Boston ivy), bittersweet, virgin's bower *(Clematis paniculata)*, euonymous, English ivy *(Hedera helix*, and *H. canariensis)*, hop vine *(Humulus lupulus)*, honeysuckles *(Lonicera flava* and *L. Halliana)*, matrimony vine, *(Lycium europhaneum)*, silver lace vine *(Polygonum Auberti)*, and creeping roses. Many additions to these lists can be made.

Send to seedsmen and nurserymen for catalogues, study garden books, and learn the type of environment these various plants need before buying for school or home. Survey the home and school grounds to determine what kinds of plants are needed and make a diagram to show what you would do if you were able to provide these plants. Pictures of many can be obtained from nursery catalogues; make a chart showing the types of birds which would be interested. Obtain Farmers' Bulletin 621 and Leaflet BS-44 of the U. S. Department of Agriculture and study data given on seasons when the fruit is available to birds.

Complaints are often registered about the devouring by birds of cultivated fruits such as strawberries, raspberries, blackberries, cherries, apples and pears. Protection of these cultivated fruits can be given by planting other trees or shrubs which ripen earlier.

Public parks, cemeteries, and roadsides are ideal places for such plantings, since the attraction of certain birds to these areas will protect the trees and cultivated lands adjacent from insect depredations. Look for instances of park and roadside planting which serve to attract birds.

Birds baths of tin, concrete or stone of a depth of not less than two inches can be made and set two feet or more above the ground and away from thick bushes as a protection from cats. A water fountain should have gently sloping sides to prevent the drowning of fledglings. A few stones in the bath will aid most birds.

Shelter and Nesting Boxes Should Be Provided.—Thickets and dense evergreens, decayed branches and tree trunks provide natural shelter for birds in stormy and cold weather, and at night. Much of this type of cover has been removed. Where the removal of this is unnecessary it should not be done. Look around your community to see what shelter is available for birds.

Nesting boxes can be provided as substitutes for natural nesting places. Working plans are given for four types of boxes that are satisfactory and inexpensive. Over 30 species of our birds utilize holes in trees for nesting. Of these only nine species have adapted themselves to regular use of artificial nesting-sites, although nineteen have been noted as using them occasionally. The size and position of the opening must be carefully planned for the type of bird that is desired.

Study Allen's *Book of Bird Life* for more details on bird homes, and their care.

Cats of course are natural predators and are a serious menace to birds around our homes. During the breeding season cats should certainly be confined at night. Nesting boxes should be placed high on metal poles or on trees with metal guards. Dogs can also frighten birds, but are not so destructive to our song birds as cats. Talk over the cat problem with the class and try to create a sentiment against unlimited production of cats in the neighborhood. The law allows a cat with a protected bird in its possession to be killed by a game warden, peace officer or person holding a valid hunting license.

Plan the Arbor Day program around plants which provide food for birds. Plant some one of the trees, shrubs or vines listed. Find data on the birds which will like this planting. Show slides or pictures of these birds and tell something of their use to man.

Local groups are usually willing to give help to those who wish it. The New Jersey Audubon Society is a State group, headquarters at 196 Market Street, Newark. Affiliated with it for bird study throughout the State are the Montclair Bird Club, the Belvidere Nature Study Club, the Newark Bird Club, the Chiakong Tribe of the Woodcraft League, the Westfield Bird Club, the Ridgewood Audubon Society, the Sussex County Nature Study Club, and the Watchung Nature Club. To meet the varied interests of nature lovers in central New Jersey, The Trenton Naturalists' Club was formed in 1938.

THE NATIVE MAMMALS OF NEW JERSEY *

Order MARSUPIALIA

1. Opossum *(Didelphis virginiana virginiana)*

Order INSECTIVORA

2. Common Mole *(Scalopus aquaticus aquaticus)*
3. Hairy-tailed Mole *(Parascalops breweri)*
4. Star-nosed Mole *(Condylura cristata)*
5. Common Shrew *(Sorex cinereus cinereus)*
6. Smoky Shrew *(Sorex fumeus fumeus)*
7. Little Short-tailed Shrew *(Cryptotis parva)*
8. Large Short-tailed Shrew *(Blarina brevicauda brevicauda)*

Order CHIROPTERA

9. Little Brown Bat *(Myotis lucifugus lucifugus)*
10. Eastern Long-eared Little Brown Bat *(Myotis keenii septentrionalis)*
11. Least Brown Bat *(Myotis subulatus leibii)*
12. Silver-haired Bat *(Lasionycteris noctivagans)*
13. Georgian Bat *(Pipistrellus subflavus subflavus)*
14. Big Brown Bat *(Eptesicus fuscus fuscus)*

* Reprinted from *The Native Mammals of New Jersey*, April 8–12, 1940.

15. Northern Red Bat *(Lasiurus borealis borealis)*
16. Hoary Bat *(Lasiurus cinereus)*

Order CARNIVORA

17. American Black Bear *(Euarctos americanus americanus)*
18. Eastern Raccoon *(Procyon lotor lotor)*
19. New York Weasel *(Mustela noveboracensis noveboracensis)*
20. Large Brown Mink *(Mustela vison mink)*
21. Canada Otter *(Lutra canadensis canadensis)*
22. Eastern Skunk *(Mephitis nigra)*
23. Eastern Red Fox *(Vulpes fulva)*
24. Gray Fox *(Urocyon cinereoargenteus)*
25. Bobcat *(Lynx rufus)*

Order PINNIPEDIA

26. Atlantic Harbor Seal *(Phoca vitulina concolor)*
27. Gray Seal *(Halichoerus grypus)*
28. Hooded Seal *(Cystophora cristata)*

Order RODENTIA

29. Woodchuck *(Marmota monax)*
30. Chipmunk *(Tamias striatus)*
31. Red Squirrel *(Sciurus hudsonicus)*
32. Gray Squirrel *(Sciurus carolinensis)*
33. Small Eastern Flying Squirrel *(Glaucomys volans)*
34. Beaver *(Castor canadensis)*
35. White-footed Deermouse *(Peromyscus leucopus)*
36. Allegheny Wood Rat *(Neotoma pennsylvanica)*
37. Rice Rat *(Oryzomys palustris)*
38. Lemming Mouse *(Synaptomys cooperi)*
39. Red-backed Mouse *(Clethrionomys gapperi)*
40. Meadow Mouse *(Microtus pennsylvanicus)*
41. Pine Mouse *(Pitymys pinetorum)*
42. Common Muskrat *(Ondatra zibethica)*
43. House Mouse *(Mus musculus)*
44. Norway Rat *(Rattus norvegicus)*
45. Hudson Bay Jumping Mouse *(Zapus hudsonicus)*
46. Woodland Jumping Mouse *(Napaeozapus insignis)*

Order LAGOMORPHA

47. Cottontail Rabbit *(Sylvilagus floridanus)*

Order ARTIODACTYLA

48. Virginia or White-tailed Deer *(Odocoileus virginianus)*

Order CETECEA

49. North Atlantic Right Whale *(Eubalaena glacialis)*
50. Common Finback Whale *(Balaenoptera physalus)*
51. Pike Whale *(Balaenoptera acutorostrata)*
52. Blue Whale *(Sibbaldus musculus)*
53. Humpback Whale *(Megaptera nodosa)*
54. Sperm Whale *(Physeter catodon)*
55. Pigmy Sperm Whale *(Kogia breviceps)*
56. Spotted Dolphin *(Prodelphinus plagiodon)*
57. Common Dolphin *(Delphinus dolphis)*
58. Bottle-nosed Dolphin *(Tursiops truncatus)*
59. Atlantic Killer *(Orcinus orca)*
60. Grampus *(Grampus griseus)*
61. Blackfish *(Globicephala melaena)*
62. Short-finned Blackfish *(Globicephala brachyptera)*
63. Harbor Porpoise *(Phocaena phocaena)*
64. White Whale *(Delphinapterus leucas)*
65. Sowerby Whale *(Mesoplodon bidens)*
66. Blainville Whale *(Mesoplodon densirostris)*
67. Gervais Whale *(Mesoplodon europaeus)*
68. Cuvier Whale *(Ziphius cavirostris)*
69. Bottle-nose Whale *(Hyperoodon ampullatus)* †

LIVE MAMMALS MAY BE STUDIED IN THE CLASSROOM

The laws of the State Fish and Game Commission should be carefully studied with reference to the keeping of any mammal in captivity or the bringing of any live mammal into the classroom for study. These laws are subject to change; if any question arises it is best to consult the Fish and Game Commission at once.

No game mammal may be taken in the wild at any season to hold in captivity as a pet or for breeding. This at present refers to rabbit, hare, gray, black or fox squirrel (there are probably no fox squirrels in New Jersey in the wild at present), mink, muskrat, otter, deer, raccoon.

Game mammals which can be bought from licensed breeders may, however, be kept in captivity by obtaining a license costing $2 per year. This license must be applied for in writing to the Board of Fish and Game Commissioners. It is issued for two purposes, (1) for the propagation of game mammals, (2) for the keeping of mammals in captivity for other purposes as for pets, and for educational purposes.

No beaver may be held in captivity at any time. No foxes may be held in captivity excepting with permission of the Fish and Game Commission and such permission is extremely difficult to secure.

Other mammals including at present

† The list of New Jersey mammals was compiled with the help of T. Donald Carter, Department of Mammalogy, American Museum of Natural History, New York City; Fred A. Ulmer, Jr. of the Academy of Natural Sciences of Philadelphia; Robert W. Storer, Chief Mammalogist of the New Jersey Field Ornithologists' Club, South Orange, N. J.; Charles H. Rogers, Curator of the Princeton Museum fo Zoology, Princeton, and Robert J. Sim of the State Department of Agriculture, Trenton.

those classed as predatory mammals: skunk, opossum, woodchuck, weasel and mice are brought into the classroom over a limited period of time for pupils to observe. It is wise to consult the Fish and Game Commission when in doubt about the use of a mammal in the classroom. Cages which will insure against escape, with metal pans on the bottom for sanitation, and with suitable provision for food and water should be used. Moore's *Book of Wild Pets* devotes almost one hundred pages to details on the care of native wild animals.

The adult opossum as well as the young can be handled safely with care and exhibited to school children. It wears a habitual scowl with mouth open exposing sharp, carnivorous teeth. In captivity it enjoys table scraps, raw beef, fish, eggs, fruit, bread, milk.

Moles are voracious insect eaters with insatiable appetites, eating almost their own weight of adult insects, their larvae, and earthworms in one day. Like the shrew, if deprived of insect food for even several hours, they may starve to death, so it is not wise to attempt to keep them in the classroom.

Bats are often brought into school rooms. Some will eat in captivity, but many cannot be kept since they refuse food and remain restless and wild. We succeeded in keeping a red bat *(Lasiurus borealis)* for six months, feeding it on a diet of mealworms, of which it consumed as many as 23 at one feeding. The mealworms were offered from a forceps. Water was welcome when presented from a medicine dropper. The superstition about bats getting into human hair, and the fear of bats, can be combatted by developing interest in the food habits of the animal through observation. As our only flying mammal the structure of the wing membrane is interesting to observe. If the bat is restless in captivity it should be released, since captive bats often die from internal injuries caused by bruises suffered in trying to fly in a cage.

Young raccoons make good and clever pets. If purchased from a licensed breeder, they can be kept for the payment of the $2 fee annually. A large outdoor cage covered on both sides and top with coarse mesh wire fencing or netting makes a good permanent home. The wire mesh should extend into the ground two feet and be anchored. For exhibition in schoolrooms, a good-sized wire mammal cage having a removable galvanized iron pan is advisable. In the outdoor cage, a hardwood tree trunk for sunning purposes should be inserted, also a sleeping box.

Pet raccoons like those in the wild wash their food, if given a bucket of water. They follow their master much like a dog and carry on many antics which amuse and endear them to the owner. They cannot be allowed the freedom of the house and eventually have to be either leashed or caged, for in their mischieviousness they can be very destructive. They eat freely of raw beef, fish, eggs, bread, milk, and clams, in captivity, and are fond of sweets.

Young skunks make good pets. The scent glands can safely be removed by a veterinarian at about the age of one month. The skunk is a digger so its outdoor pen must be fenced with wire which extends three feet into the ground with an inward turn toward the bottom. In captivity skunks will eat table scraps, most meats, fish, cereals, bread, dog food, eggs, milk (milk should be fed sparingly), fruits, and they relish bones to gnaw on.

The skunk eats a great many insects, especially Japanese beetle larvae, and mice. Seton writes in considering their native food habits in relation to man: "Every skunk is the guardian angel of a garden acre. To destroy the skunk is to devastate that acre."

To learn the habits of mammals most teachers today utilize domesticated mammals such as the guinea pig, white rat, the white mouse, and the rabbit. Every school should own appropriate wire cages for the

confining of these animals for breeding purposes. Such cages should always be equipped with a galvanized iron pan which can be cleaned daily. Government bulletins on the care and breeding habits of these animals can be obtained from the Superintendent of Documents, Government Printing Office, at Washington, D. C.

Write about any experiences that you have had with live native mammals. What reasons may be advanced for preventing the keeping of native mammals in captivity? Make cages to accommodate white rats and guinea pigs. These can be made of screen wire on wooden frames setting in a pan of galvanized iron. A screen wire cover for the top should fit neatly. Often the young of mammals such as rabbits and gray squirrels, and flying squirrels, lose their parents, or fall out of the nest and must be cared for by people. If the helpless young mammal is one classed as a game animal permission to raise it must be obtained from the Fish and Game Commission. What would these young be most likely to take as food? Arrangements can sometimes be made with the Game Management Division of the Fish and Game Commission to borrow and exhibit live game mammals.

ELEMENTARY SCIENCE FOR DIFFERENT ABILITY LEVELS

Otis W. Caldwell
General Secretary, A.A.A.S.

The excellent progress of science in elementary schools has thus far taken little account of differing pupil capacities. There are many inherent difficulties in securing a differential organization of subject matter even in the more clearly defined subjects as reading, spelling, or arithmetic; and part of these difficulties seem to be still greater in science. Most supervisors who offer any advice, say that superior pupils should be allowed to progress more rapidly in a subject, that the middle group should move at a normal rate, and that the slow pupils go along as they can. There are not enough tested and proved experimental results to give us much more than suggestions about procedures in adjusting subject matter to slow learners. The needs and opportunities should elicit research attack from some group of workers in science teaching.

Let us begin with an idea that is somewhat more fundamental than is generally recognized in statements of what education may accomplish. In my first rural district school there were five pupils from one family. In range of ability these five were fairly representative of the fifty-five pupils who composed the school. The differences among the five in capacity to learn were so great that neighborhood curiosity expressed wonder that four brothers and one sister should vary so widely in capacity to do the book work which made up most of the school's set program. One of the five was so bright that his mastery of assigned lessons left most of his time for ingenious though not malevolent annoyances to his untrained teacher. Another was so slow in mastery that the foot of his class became his undisputed possession. This slow pupil steadily desired to learn and so faithfully blundered through the year, that his yearly promotion to the next class would have been denied only by a harder-hearted teacher than the one then in charge. All of those five pupils are still living, well past middle age. All are good citizens. The slow one is still slow in book knowledge, but in the qualities which compose recognized character and influence, he is the leading citizen in a large rural area of

average rural citizens. Although the five differed widely in mastery of school subjects, and although all are now good citizens, there is probably less variation in their effective community relations than was shown in their school achievements.

There is a second fundamental and very different kind of idea which can best be presented by an illustration from the field of applied biology. A famous trotting horse, a gelding known as Greyhound, holds the world's trotting record of 1:55¼ for one mile. Uhlan, now dead, when hitched together with a running mate, trotted a mile in 1:54½. Rosalind holds the world's mare trotting record of 1:56¾, and the stallion, Billy Direct, holds the world's pacing record of 1:55. The three of these horses which are still relatively young, are no longer useful in racing competition because they have no close competitors. That is, prize races are no longer available to Greyhound, Rosalind, and Billy Direct because there are at present no race horses near enough to them in speed to place them in the competition classes of these record holders. Therefore, Greyhound will be used for exhibitions, Billy Direct and Rosalind will be used for transmission of their inherited qualities to a new crop of potential race horses.

Long distance speed records, and retention of speed qualities to old age are quite as significant, though less spectacular, than are the records for single mile performance. For example, Peter Manning's 1925 record of 4:10¼ for two miles has not been broken; Nightingale's 1893 record of 6:55½ for three miles still stands; Bertie R's 1899 record for four miles of 9:58 still stands; also Pascal's 1893 record for ten miles of 26:15 stands. Maud S. made a world record of 2:08¾ when she was eleven years old, and Goldsmith's Maid, when seventeen years old, trotted a mile in 2:14½.

Those horses, and a few others, which early in their lives showed superior possibilities, received large amounts of studied care and training, that is, they had the best horse education. Outstanding successes have eliminated these horses from participation in the kinds of contests in which their successes were achieved. Their remaining value is chiefly in the possibility of inheritance by others of the qualities which when subjected to training may make further racing participation possible for their descendants.

Thousands of colts annually are given preliminary training, the purposes being speed and endurance. A few hundreds pass these first equine tests of physical qualities, of requisite intelligence and early achievement. Those few thereafter receive graduated, prolonged and intensive training which may finally cumulate in outstanding achievement for a small percentage of the few. From the very first training, there is a continuous process of discarding unpromising individuals. The thousands of discards may be retrained for use as riding horses, dude ranch horses, some even farm horses, hack horses of all sorts, wherever horse work may be found for them. While there is great pressure in finding places for the discards, it is but rare that one is so poor in quality that he must be destroyed, though some are almost useless. Obviously, however, there is a large number of colts with really good inheritance which cannot be trained for racing, hence need to be given appropriate types of training or retraining for the much larger amount of more constant and thoroughly respectable horse work that is not on the race course.

Inferences from analogies are not fully dependable, but, if critically made, may be helpful. Implications from these two illustrations so far as they are valid are fairly obvious.

Sixteen years ago the University of the State of New York [1] held a conference to

[1] University of the State of New York Bulletin, No. 824, 1925.

consider ways of improving teaching for superior pupils. All agreed that superior pupils need attention. Since that date valuable experiments have been made in teaching gifted pupils. From my own paper presented at that convocation a few sentences are quoted:

(1) Undoubtedly schools have lost to society some of its best brains by failure to keep rapid learners learning rapidly.

(2) An accelerated "eight-year-old boy is usually biologically, physiologically and socially an eight-year-old boy."

(3) To cause such gifted pupils "to move more rapidly in subjects of study which are organized for pupils of older biological ages may gain intellectual occupation for a time at the expense of social growth and adjustment."

(4) There are "tragedies of gifted people who moved rapidly in merely intellectual acquirements, but who then passed out of their proper and normal biological and social groups without passing into other appropriate groups. Their gifts were the occasion of their becoming social failures."

(5) What is needed is the "use of material and situations which are commensurate with the pupils' biological social and intellectual ages."

At that convocation A. J. Stoddard discussed the Dalton Plan, and The Winnetka Plan, and another speaker also presented the parent of those two plans which was Burke's Plan of three decades ago in the San Francisco Normal School. Stoddard stated that "The Dalton Plan makes no attempt to revise or adjust the subject matter of the curriculum but, rather, offers a method of procedure by which the child progresses and acquires habits, knowledge and skills." Large benefits are and will continue to be derived from the Dalton, Winnetka, and other improved methods. The fact that they individualized a pupil's work in highly useful ways in schools, where the methods are applicable constitutes a conspicuous contribution to American education. Two points, usually overlooked, should be recalled: (1) that Miss Parkhurst first demonstrated her plan by teaching a slow-learning pupil at Dalton, Mass., then added other pupils somewhat similar, then used a large city school of superior pupils; and (2) that the effort was not primarily to adjust subject matter to differing abilities but rather to gain speed and clarity with the accepted curriculum.

For twenty years measurements have differentiated a large so-called "nonacademically minded" group, a group above mental defectives, but below those who learn readily. This is a large group of pupils who have difficulty or who cannot do what the schools ask them to do. Pintner [2] finds that high school pupils whose I.Q.'s are between 90 and 100 find it very difficult to complete a high school course. In the Pennsylvania Study [3] reported in 1939, it is stated that between 40 and 50 per cent of high school pupils are below the level of capacity which may satisfactorily accomplish the work now presented to them. Other studies covering nation-wide data [4] assert that approximately 40 per cent of high school pupils should be regarded as being in this "nonacademically minded" group. If this is true of almost half the high school population, as shown in the Pennsylvania study, it is a serious situation. What about those in elementary schools? The same or even wider variations exist in elementary schools because the lowest pupils in I.Q. usually do not reach high school.

It is an old and true statement that, in an earlier period, the curriculum was planned for children who, in the main, came from parents who had professional ambitions for their children. The terminology still used, that is "academically minded" and "nonacademically minded," has the stamp of the earlier purposes of education. Speakers would not need to refer so often to this fact if only we had done more to

[2] Pintner, Rudolph. *Intelligence Testing.* Henry Holt and Company, 1931.

[3] Secondary School Principals of Pennsylvania. *Brief Outline of Curriculum Studies for the Non-College Pupil in Pennsylvania Secondary Schools,* 1939.

[4] National Association of Secondary School Principals. *That All May Learn.* Vol. 23, Number 85, 1939.

make curricula to suit the needs of a wider range in school population and individual capacity. No end of papers and books have been published in condemnation of an exclusively academic curriculum; far less has been done to make the needed changes in actual work in schools. There are 97 publications cited in the best study yet published dealing with education of what that study calls "this educationally neglected group." [5] Of these 97 publications, but few undertake to provide specific information to the classroom teacher as to how to improve education for the "nonintellectually-minded" group. The philosophic arguments are usually followed by earnest admonition to teachers but not by specific guidance in just what to do.

A few significant experiments are in progress, not in science, but these may help in planning experiments in science. In experimental teaching of mathematics to slow-learners, Schorling [6] and his associates cite three initial discoveries which are pertinent to the science teacher's problems. First, slow-learning pupils can read less effectively than others of corresponding ages, hence do not understand so well whatever they read. Second, such pupils need very clear and abundant experiences and observations as basis for work with any kind of mathematics. Third, slow-learning pupils as a group, as well as their parents, are usually dissatisfied, adversely critical, or even rebellious about school work. This third point, which seems to be a direct result of lack of success in school work, may account for a measure of adult dissatisfaction with public education. Therefore, those in charge of the mathematics experiment began by teaching reading, and by providing abundant concrete experiences upon which later work in mathematics could be based. By selection of simple and practical mathematical units, the mathematics of the working world, and by teaching these until a high degree of mastery was achieved, concepts, manipulation, and appreciation were developed for use in later units. Incidentally, but of great importance, pupil attitude and parent enthusiasm about school were improved. It is the belief of those who have made these experiments in mathematics that quality of achievement in mathematics of the workaday world, not quantity, is supremely important for the nonacademically-minded group. Slow learners do not achieve so high quality, or nearly so much work as do superior pupils. The units studied by this group differ somewhat in kind and greatly in amount from the regulation course outlined for the "college" group, though the kind consists chiefly of the simpler elements of the more comprehensive course. The reports thus far published regarding this study with mathematics do not inform us of the lowest I.Q. range with which it is possible to achieve the improved quality of mastery in reduced amounts of work. The high moron is "out" so far as mathematics is concerned. Though he is still present in many schools, in those where the experiments were made the lowest pupils are in special classes for their kind.

An extensive experiment in reorganizing work in the arts in the Detroit elementary schools provides the science teacher with added suggestions. It is reported that all sorts of things to do in the arts, both industrial and fine arts, have been organized into graded series of assignments suited to different ability levels within each grade. In a given classroom the pupils may be working upon several different units. As I read the reports I understand that these units are not intended to be merely different stages in a single unified course of study, but to some extent they are units of different nature appropriate for different capacities and interests. Those who have

[5] The Bulletin of the National Association of Secondary-School Principals. Volume 23, Number 85, 1939, entitled, *That All May Learn*.

[6] Schorling, Raleigh. *Needed Research on the Problem of the Slow-Learning Pupil.* Paper read at the meeting of Section Q, A.A.A.S., 1935.

capacity for speed and long distance achievement in arts are given the types of units which develop such capacities. Those of low capacity whose ultimate achievement may be chiefly an enjoyable appreciation of art, are given types of units designed for that kind of capacity. For gifted pupils, special Saturday and after school classes are organized.

In Junior-high-school science we have long had a kind of gradation for two or three ability levels. It is doubtful whether as much use is as yet made of these gradations in classroom practice, as is made of them by earnest book salesmen. We could hardly claim that minimal essentials, with added optional units for superior pupils, and extra optional work for gifted pupils have been developed through accurately measured experiments. Experienced teachers have developed these adjustments for differing groups through unmeasured, but no less real, trial and error procedures.

Our most commonly used, but not easily-defended adjustment, is not our system of adjusting science to differing needs, but our system of grading or marking our pupils. In the main (with many individual exceptions), our slow learning pupils with I.Q.'s between 75 and 95 study the same material as others but receive low marks thus indicating low mastery; the middle group (I.Q.'s 96 to 109) receive good marks; and the superior and gifted (I.Q.'s 110 to 150) receive distinctive marks. It is our system of grading not our subjects or methods, which is our chief adjustment to different ability levels.

In science in elementary grades, we have the greatest opportunity and the least accomplishment in adjustment to differing abilities. Plasticity of program in elementary science still exists. Almost no general standards of pupil success are set up as conditions to the pupil's further progress. We hear of "failing to pass" in physics, chemistry, biology, occasionally in general science, but not in elementary school science. It is truly a remarkable subject which may be presented to the widest possible I.Q. range without the disappointments of failure that are associated with more conventional subjects. That fact, instead of being harmful, can be made one of the strongest features of elementary science because we are not tied by a standardization that will hamper the experiments that are needed.

Might it not be useful if eight or ten supervisors and teachers of elementary science would cooperate in some definitely planned experiments? I suggest a working procedure, subject to such changes as good reasons may indicate.

A PROPOSED EXPERIMENT

I. *Recognition of the situation.*

1. The elementary school population consists of boys and girls ranging in intellectual capacities from a small percentage of high morons, to slow learners, to a large central group most of whom have high school and some have college expectations, to the "academically-minded" group, to a small percentage who are highly gifted or of genius capacity.
2. All these young people, except those identified as imbecile or criminal, will be citizens, and a duty of education is to promote their physical and mental health, their understanding and use of the common knowledge that serves in the day's work, their home and community membership, their recreations and pleasures, their working habits, and personal and social attitudes.
3. Elementary Science is ubiquitous throughout human habitats, and contains unavoidable as well as avoidable contacts, experiences, reflective and creative elements, vocational, intellectual, artistic, and recreational elements. The question is not whether science will be part of one's education, but how it is used in education, and how much of it will become one's conscious possession.

II. Without attempting now to make a complete statement of how to proceed, the following quotation from Dr. Dewey provides a general guide. "Arrange for the kinds of experiences, which while they do not repel the student, but rather engage his activities, are, nevertheless, more than immediately enjoyable since they promote having desirable future experiences." That is, each ability group should achieve satisfying results which shall be related to future needful experiences.

III. The material to be studied, the experiences to be chosen, the ventures to be engaged in, the science reading to be used, may be selected from the frame work of existing outlines of elementary science, supplemented by additions which become desirable as the experiment proceeds.

IV. As basis for further consideration, I venture the following outline as illustration of a possible set-up for trial.

1. Suggested pupil group to be used. An ordinary fifth grade of boys and girls ranging in I.Q. from 80 to 130.
2. Reading ability good, with a few low I.Q. pupils unable and uninterested in reading outside their simplest school books. At the other extreme a few pupils who use the library and read one or two children's magazines.
3. Previous science mostly desultory and informational, including trips to parks, zoo, farming and recreational regions. No home or school laboratory experience. (At beginning of experiment make this inventory of background as complete as possible.)
4. A regular period on the program for conferences, discussion (group and individual), planning things to do, reporting progress, deciding next steps (or next units if one has been completed), recording and filing reports of work done, etc. At start, this period used for general discussion with all pupils to initiate interest, cooperation, pupil suggestions resulting in individual or small group assignments.
5. Types of subject matter.

First series—three ability levels.

(a) How many and what kinds of birds live near your school or your home? (This suitable for trial with the poorest pupils in the class.)

(b) What is the food of the birds which nest about your school or home, and what harm or good is done by the birds eating this food? (This suitable for trial with the middle group of pupils.)

(c) Make a large chart showing the annual migration routes of a half-dozen birds which nest about your house. (This for upper group.)

Second series—four ability levels.

(a) Make a collection placed in a pupil's individual box of all the kinds of metal (or stones, or wood, or cloth) you can find and name each kind.

(b) Make a map of North America showing the sources of different minerals and show the routes over which most of these are transported.

(c) Learn how common soap is made, plan and carry out a project in soap making, keeping account of all costs, and estimate the value of the soap made in this project.

(d) With a guide, visit a soap making factory (a cotton mill, a cabinet shop, an oil refinery) and prepare an illustrated class and assembly talk upon raw materials used and their sources, the general processes of manufacture, the nature and disposition of the products.

V. *Judging results of such an experiment.* Probably it would not be easy at any early date to evaluate results in a statistically accurate fashion. That could be developed later. Undoubtedly descriptive results would be possible and might guide to further experiment. After trial and correction, these or other units could be measured through use with matched groups at different ability levels.

The task proposed is large, not all of it could be undertaken at once by one group of workers. If, however, several persons would experiment with any given year's work, the results would disclose the relative advisability of any further attack.

VISUAL AIDS AND AMATEUR PHOTOGRAPHY

Ellis C. Persing
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The number of teachers becoming interested in visual aids and in producing some type of such material has increased rapidly during the past few years. This augmented activity in teacher-preparation continues to gain momentum. It is likely that the popularity of the so-called candid camera, together with the recent extended developments for uses of pictures in our newspapers and magazines has influenced teachers to evaluate some of their snapshots and post cards for use in connection with certain units.

In larger cities the amateur photographs will supplement the visual type of prepared materials which are available from a central source. For the smaller school system the results of the amateur's photographic efforts will do much to help make instruction more effective. In the smaller school system the pictures produced by the amateur photographer and the teacher keenly interested in visual aids can be made to help enrich the curriculum.

Since motion and action are not necessary for many objectives of science instruction, the still picture should find a place in our list of visual aids. When motion is not an element, the still picture offers an advantage for detailed analyses.[1]

The writer assumes that the standard visual equipment provided for school use will include good prints. Even though some of this material is available, the teacher can do much to make the pictures vital to the unit by obtaining views from the immediate environment. If we are preparing units to include the local environment, it seems logical also to use pictures of the actual items of the immediate vicinity, rather than pictures far removed from the local area. This procedure does not mean a lowering of the standards for selecting the pictures.

During the past five years the writer has conducted courses in the School of Education, Western Reserve University, in photography and methods in visual education for teachers. The reaction indicates that teachers are keenly interested in making pictures to meet their immediate needs. They are interested in developing the technique by which pictures are made. They can make pictures that excel in photographic quality. These teachers have made pictures that were accepted in the local exhibits as well as in national exhibits.

STILL PICTURES

There are several types of still pictorial aids such as contact prints, projection prints or enlargements, stereographs, lantern slides, transparencies, and film strip. All of these offer possibilities for teacher-made and pupil-made pictorial aids.

To make any of the foregoing, one needs a good negative. This may be obtained by making the exposure with the film in the camera and then either developing it or sending it to the photo-finisher. If the school has a photographic darkroom, it is good practice for an experienced teacher to do the processing.

The negatives should be placed in envelopes (there are special envelopes for this purpose), labeled, and filed for use as needed.

It is now a simple procedure to select the negative for one type of visual aid as needed for a certain unit.

CONTACT PRINTS

Since the negatives will vary from 1½ in. x 1 in. to 4 in. x 5 in., one will need

[1] Charles Hoban, Charles Hoban, Jr., and S. B. Zisman. *Visualizing the Curriculum*, Chap. 5. New York City: The Cordon Co., 1937.

to determine the size necessary for instructional purposes. Even contact prints from the miniature negative meet certain needs, such as illustrations for notebooks. One advantage of this small print is the relative low cost. The contact print is inexpensive and easily made.

The larger prints such as the 8 in. x 10 in. or 11 in. x 14 in. sizes are better for class or group work. If one is in doubt about the values of the different sizes for print, it is a very interesting experiment to show the same subject on a 4 in. x 5 in. print, then use one 8 in. x 10 in. or 11 in. x 14 in. and observe the reaction of the pupils. After a demonstration, and with a little help from an amateur photographer, the teacher can easily make enlargements from her own negatives for class work. This procedure has been demonstrated to the writer's satisfaction.

Post cards can be purchased and can serve as a source of still pictures. There are two types of such cards. One is the black-and-white photographic print, which is usually very good. There is also the reproduction in color, which is even less expensive than the photographic print. For group work such pictures can be shown by means of an opaque projector which will be discussed under "Equipment."

LANTERN SLIDES

The same negatives used for making the prints can also be used to make lantern slides. The process is much like making prints, but the picture is made on a piece of glass instead of on paper.

If the negative was made with a miniature camera using 35 mm. film, one can use the 2 in. x 2 in. lantern slides, which cost about 20 cents a dozen, or about half the cost of the regular-size lantern slide.

The larger transparencies, 8 in. x 10 in. or 11 in. x 14 in., can be made from any of the negative sizes already mentioned. The negative is placed in the enlarger, and the film is printed by projection. Directions for the making and use of transparencies will be found in the books on photography.[2]

COLOR PHOTOGRAPHY

The value of the picture in natural color is generally recognized. Until recently only the person skilled in the photographic processes or certain techniques of art could produce satisfactory pictures in color. There are several different kinds of color film available, but up to the present time Kodachrome seems to be most successfully used by the amateur and especially the beginner.

By using the 35 mm. size, one can produce a lantern slide in natural color for less than 25 cents each.

This small-size film, in Kodachrome, is satisfactory for classroom and general auditorium use since it can be projected on the screen to almost any desired size. Even the small-size picture projected to a large size on the screen is sharp, clear, and brilliant in color. There seems to be no valid argument for using the regular-size lantern slide in natural color, since the cost would be considerably greater. Therefore, the teacher, club, or school may make their own color pictures at a very reasonable cost.

SUGGESTED SUBJECTS FOR COLOR

The general habitat of plants and animals, views of fields, forest, and gardens, are subjects suitable for color film. Even though pictures of birds in color are more difficult for the inexperienced photographer, they are well worth the effort. Close-up pictures of wild flowers showing detail of petals, pistils, and stamens are essential for certain units. Insects are good subjects for the color camera, but are often difficult to photograph unless one has a camera with features adapted for the purpose. It is difficult to realize how rapidly one can build

[2] Jacob Deschin. *New Ways in Photography.* New York City: McGraw-Hill Book Co., 1936.

up a library of lantern slides in natural color.

The writer has seen excellent pictures made with an inexpensive type of camera, and for certain work the less elaborate camera will be satisfactory. However, one should decide on the kind of photography to be done and select a camera with those needs in mind.

Since most people have cameras for black-and-white films, the writer will keep the suggestions chiefly to color work. For general views and objects not closer than four or five feet, one can secure a camera for 35 mm. film at a cost ranging from about $22.50 to $30, and up. However, if one wishes to make close-up pictures or to do copy work, additional equipment or another kind of camera will be necessary. The writer has found that a camera for 35 mm. color film and another camera for black and white of the same size or one for 4 in. x 5 in. cut film makes a satisfactory working outfit.

THE PHOTOGRAPHIC DARKROOM

Nearly every school has a small room that can easily be made into a darkroom. Be sure that it is lightproof and as nearly as possible dustproof. Make it a workroom with tables for enlargers and equipment, and shelves for supplies. If possible, provide a sink and running water. Begin in a simple way and gradually add to the room as items are needed. Some of the new books on photography give excellent plans for a darkroom.[3]

For making contact prints one needs a printing frame or a printing box. The photographic dealer carries these in stock, and one can select according to the funds available. These pieces of apparatus can be used in connection with the science or photographic club as well, as for teacher-pupil-made projects.

The enlarger is essential if one is going to make the large 8 in. x 10 in. or 11 in. x 14 in. prints. It is becoming increasingly difficult to select an enlarger because of the large number of firms making them.

If one is making prints from 35 mm. film, it is better to purchase one of the 35 mm. enlargers such as the Leica, the Eastman, the Elwood, or the 5 in. x 7 in. Elwood with the miniature attachment. (The writer is familiar with the foregoing.)

For the larger film sizes there are numerous enlargers. As a type of enlarger one might consider the Eastman, the Elwood, and many others. The enlarger offers numerous possibilities for making visual aids.

The astounding results obtained with 35 mm. Kodachrome warrant the expenditure necessary to purchase a projector for 2 in. x 2 in. slides. There are several such projectors on the market suitable for the classroom and auditorium. The writer has used the Eastman, the Society for Visual Education, and the Leitz projectors satisfactorily in both college and public-school work.

One should select the easier photographic projects to begin with. For example, one cannot hope to make both the negatives and lantern slides for such a subject as "making maple sugar" in a short space of time.

Do not try to compete with the commercially prepared visual aids but rather supplement them.

It is profitable for several people to meet for demonstration and discussion of problems. Organize a small club to work on teacher-made visual aids.

[3] For example: Willard D. Morgan and Henry M. Lester. *Leica Manual*, Chap. 8. New York: Morgan and Lester Publishing Co., 1938; and Ansel Adams, *Making a Photograph*, pp. 22–31. New York: Studio Publications, Inc., 1935.

SOME OBSERVATIONS ON NATURE STUDY AND ELEMENTARY SCHOOL SCIENCE

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The writer is one of the last ones to take the ordinary statistical study too seriously. Nevertheless it is interesting to compare returns obtained by similar techniques over a period of years on subjects which are more or less controversial.

One of the questions on which we hear much is that concerning whether there is an increased consideration given the teaching of nature study or science in the elementary years. One measure might be the percentage of schools offering the work by each grade from approximately a similar number of schools similarly selected. To satisfy his own curiosity without originally intending to publish on the subject, a survey was made of this situation in 1939 in 154 communities. These returns were compared with those made in 1925 by Clelia Paroni of Oakland, California, and with those published in 1905 by Bruce R. Payne in *Public Elementary School Curriculum*. The number of schools involved varied from 50 with Payne to 199 with Paroni to 154 in this study.

The results were as follows:

TABLE I

Percentage of Schools Offering Science in Different Elementary Schools

Grade	1	2	3	4	5	6	7	8
Payne 1905	64	68	64	60	54	44	48	44
Paroni 1925	73	73	75	75	70	67	45	43
Palmer 1939	45	47	53	55	58	57	45	46

In the three studies the Payne figures were based on 50 courses in Elementary Science and Nature Study, the Paroni figures on Nature Study and the present study on courses in Nature Study and Science. It is assumed that the readers will wish to draw their own conclusions.

In the present study it was shown that 110 of the 154 communities provided a definite time in their program for this work.

The problem of responsibility for supervision was considered in Miss Paroni's study and here. Eighty-four of Miss Paroni's 199 communities reported no special supervisor; 11 of our 154 gave a similar response. In 31 of Miss Paroni's communities supervision was provided by the regular grade supervisor and this was the case with 19 of our communities. Sixteen of Miss Paroni's communities had a special nature or science supervisor and 24 of ours had this help. Eleven supervising principals were responsible for this work according to Miss Paroni's study and 27 of these officers functioned in this capacity in the recent study. The Paroni figures showed 10 school superintendents providing supervision while our figure was 23.

The present study showed 99 of our schools equipped with motion picture projectors; 60, with special demonstration equipment; 59, with buses for excursions and 51 with special school museums.

Of the 154 communities here reported, 72 built their program around some specific textbook; 42 used no texts; 57 had guides prepared by local teachers; 33 used a state syllabus and 6 had outlines prepared by principals or supervisors.

In the present survey it was shown that there was varying emphasis on viewpoint. Comparing the emphasis given conservation, health and humaneness in the nature and science programs, we find that of the 154, 80 emphasize conservation, 17 putting it first of the three; 80 claim to be emphasizing health, with 43 putting it first; 77 report emphasizing humaneness with 6 putting it first. A host of other viewpoints

were evaluated but need not be given here.

It was encouraging to note that, in three of the cities reporting, this work had been an established part of the program for over 40 years; 10 had emphasized it between 20 and 30 years and 22 had started it within the last 5 years.

Of the 26 states on which we have comparable data on time allotment, the reports would indicate that Florida leads in number of minutes required in the elementary grades followed in order by Texas, Iowa, Illinois and Missouri. Among the low ranking states on this basis are communities in Alabama, New York, New Jersey and Oregon. Adequate returns on this point were not forthcoming from 14 of the 48 states reporting.

of the cluster flies which force themselves into all school rooms in the fall and force themselves out in the spring. We attempt to explain the details of heredity and of historic geology and astrophysics but we forget the physics and chemistry and biology of the cobwebs that hang at some time from every school room ceiling. With our intellects we explore the intricacies of molecular nature of matter and we chase electrons up and down various conductors but almost no outlines or programs set out seriously to improve the ability of youngsters to understand chemical differences in their environment through evidence of the senses.

Our state programs mandatory for use usually only in the rural schools are often

TABLE II

REPORTS ON 154 CITIES' WEEKLY AVERAGE TIME ALLOTMENTS TO NATURE STUDY AND ELEMENTARY SCIENCE, 1939

Grade	Kind	1	2	3	4	5	6	7	8	9
Minutes Required	35	42	44	51	68	85	80	144	171	196
Minutes Allowed	43	53	55	62	80	91	91	151	140	212

An examination of the outlines submitted indicates a trend away from the study of specific organisms and substances but a continued segregation of the content of the different fields of science. Much is said in the introductions of the more recent outlines about science for general education and science for life but usually this is for general adult education and science for adult life. One looks in vain for the science of spit-balls, whispers, wet clothing and other things close to the child's heart and skin. We still divide botany and zoology and geology and, if and when we teach about sound to a bunch of squirming youngsters, we look to our physics books for our suggestions and forget about the biological significance of sound and of other physical phenomena. While we teach about extinct dinosaurs which the children will never see alive, and the teachers never saw alive, we do nothing with the phototropism, thermotropism, thigmotropism and other tropisms

prepared by persons experienced only in the urban problems of organization. Materials are generally selected by the grab bag technique with comparatively little thought of series of significantly difficult and appropriate steps. Too frequently our focus seems to point towards encouraging the development of the arm-chair or laboratory scientist without thought of helping people young and old enjoy nature in the raw in all of its moods. We teach of the vanished passenger pigeon and say nothing of the vanishing shore birds. We chase hippopotomi up the Nile and salmon up the Columbia but forget to chase the rabbit in the back yard and find out what he is doing. Incidentally we will probably continue to chase salmon up the Columbia in our texts long after the salmon have been stopped from chasing each other up it by the new dams being constructed there.

Our programs teach of deserts and dust bowls but forget the four deserts at the

corners of a baseball diamond or on an ash pile. We talk of glaciers in the far north without mention of those which hang from our school roofs. We talk of climates but rarely illustrate what we mean by calling attention to such microclimates as those which exist in our ears, on our book shelves, under logs and so on. We have made progress but these are some of the fields in which it seems we could well call our imaginations into play to make of science in the elementary grades a truly functional experience for the children of those levels.

THERE IS CO-OPERATION, TOO

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When we oldsters were youngsters the world was all agog over Darwin's *Origin of Species*. There is, in Huxley's apt phrases, wide variation among animals and plants, a geometrical rate of increase, a consequent keen struggle for existence, and a survival of the fittest. Nature is "red in tooth and claw." Starting with a single dandelion plant with its dozens of blowballs and its thousands of seeds, you can figure out that its offspring will cover the earth in less than a decade. A single female codfish laying three million eggs—a perfectly normal procedure—gives rise in a few generations to so numerous a progeny that the ocean would be a solid mass of cod. But the earth is still not covered with dandelions, and codfish seem no more abundant than they were in Darwin's day. The hypothesis is contrary to fact. The fecundity of nature affords food for the hungry, not embattled hosts for conflict.

My pound of baked bass represent 6 pounds of minnows, 36 pounds of scuds the minnows have eaten, 216 pounds of water fleas the scuds have consumed, 1,296 pounds of paramecia the fleas have gobbled, 7,776 pounds of bacteria and other tiny plants the paramecia have engulfed. A single bacterium will give rise to a mass of them as big as the earth in a week if reproduction continues unhindered. From such catastrophe a sacrificial devotion to the hunger-needs of the higher-ups alone saves us. Dandelion seeds are on the bill of fare of dozens of birds and other hungry creatures, and fish eggs are devoured by many beasts that would not know the meaning of caviar on the menu.

Multicellular organisms are an impossibility without cooperation. Roving independent cells that went hither and yon and did as their individual desires dictated had to give up their independence and serve the needs of their fellows when pandorina or volvox came into existence. I am a cooperative association of hundreds of millions of cells. Let a few of them go on a strike and refuse to do their share in the mutual enterprise and I die.

When an organism comes into existence by the development of a single cell, a fertilized egg—and most of them do so arise —it is a manifestation of cooperation that is almost past belief. The egg divides and subdivides. The multitude of cells so formed differentiate, each to suit the particular work it must do in the whole. Each cell moves to its appointed place. There is no hesitation, no jostling, no confusion. A nerve cell in my developing spinal cord thrusts out a fine strand of its substance, a nerve fiber, that runs out among the tissues to a particular terminal in the tip of the index finger of my right hand. This growing strand of protoplasm finds its way unerringly among the millions of muscle cells and other cells already properly

located. You have such a nerve element similarly located, terminating like mine. Imagine a great factory putting itself together. Steel beams for the framework, floor girders, bricks, tile, roofing slates, wheels, axles, bolts for the machinery, all shaping themselves out of the raw materials and going to their proper positions, taking their appointed places, no workmen to help, no boss to supervise. The development of an organism from the egg is a cooperative enterprise that staggers the imagination. It still will be when and if we ever succeed in unraveling the intricate chains of causes and effects that naturally produce it.

In the northern oak woods of early spring, the ground is sprinkled with clumps of hepaticas. Then appears a carpet of spring beauties interspersed with bloodroots and spotted adder's-tongues. These fade as trilliums come into bloom. Then come shooting stars, wild geranium, and columbine. So the succession continues throughout the summer and fall until paths are bordered with royal goldenrod and finally with the white snakeroot, *Eupatorium urticaefolium*. The orderly procession of plants in the woods you know best —East, West, South—may not be the same, but there is a succession. Similar ones occur on the open prairie, the desert, the swamp. It is as if each species hurried through its life-cycle to make way for its successor so as not to appear hoggish. With the politest of manners each bows its way off the stage as the next actors in the drama take their cue. The production of a Shakespearean play is not a more cooperative enterprise.

The open dunes along the southern and eastern shores of Lake Michigan support a sparse population of cottonwood trees and their associated shrubs, herbs, and animals. Back a bit farther from the lake the cottonwoods are replaced by pines, junipers, and quite a different lot of plants and animals. Then this pine association gives way still farther inland to black oaks, red oaks, white oaks. Hickories appear, then hard maples, and finally the beech-maple climax forest with its characteristic shrubs and herbs and animal inhabitants. It looks as if each association were crowded out by its successor. But as a matter of fact it is just one more case of cooperation. Not until generations of cottonwood trees and their associated shrubs, herbs, and animals have lived, died, and moldered in decay does the sandy soil contain enough humus to support the pine association. It in turn adds sufficient enrichment in the course of time—a long time, at that—to make it possible for the black oak association to appear. The living things in each zone are preparing for their successors.

There is competition among the creatures of the earth. To deny it would be foolish. The introduced English sparrow crowds native songsters off the map for a time. Then it in turn gives way to the starling. But the principle of cooperation is even more widespread and important. How plants maintain the oxygen supply that they and the animals too require in respiration, while the animals renew, in large measure, the carbon dioxide so essential in the photosynthesis of plants is familiar to almost every school child. The nitrogen cycle is another example of absolutely essential cooperation. It is the most cooperative creatures, the social animals—ants, beavers, and their like—that are and have always been in the vanguard of progress.

THE SCIENCE ADVISOR PLAN IN CHICAGO

Margaret L. Wilt
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The science advisor plan now functioning in the elementary schools in Chicago was initiated some years ago when science demonstrations were being given by classroom teachers throughout the city. Science advisors were selected from the teaching staff to assist demonstrating teachers in planning their work. The need for such assistance arose because many elementary teachers felt that their science training was inadequate and that their background in science was insufficient to insure a well-planned science program. The duties of the advisors were to help the teachers plan units of work, to develop individual lessons, to suggest and secure materials, to prepare reference lists, and to make frequent visits to note the progress of the work in the classroom. Assistance of the various types was given to certain schools chosen as science centers during the period of the demonstrations. When the period ended, two advisors were retained to continue the work. One was assigned to the North Side schools, and the other to the South Side schools. The extent of the territory prohibited a systematic visiting program. The advisors were subject to call by district superintendents, principals, and teachers to schools where help was needed or desired. The numerous calls for assistance showed that there was much interest in elementary science.

Recently the number of science advisors was increased to eight, one for each school district. They function under the director of science. The scope of the work was enlarged. Regular office hours in the district office were established for each advisor so that individual and group consultations with teachers could be held. In some district offices where space was available a special room for science conferences and exhibits was established. A systematic program of visiting was started.

The primary function of the science advisor is to act as consultant to teachers in the schools. On the first visit to a school, the advisor, through the principal, usually calls together small groups of teachers to discuss science-teaching problems of particular interest to them. These discussions relate to a wide variety of subjects such as pupil-needs, subject matter, grade placement, time allotment, materials, and books. Thus the local problems and needs of the various grades within a school are discussed with the science advisors. A free exchange of opinion and thought is typical of these meetings. There is a distinct advantage in having the science advisor selected from the teaching staff. Teacher meets teacher on an equal basis, with the result that there is much freedom of expression. Each adds her bit to the solution of the difficulties presented. Such meetings help the science advisor to get acquainted with the teachers, to become familiar with the present science program of the school, and to plan ways by which she may be of greater service in future visits.

It is the general plan that all the schools in the district be visited before a second visit is made to any school. (Exceptions are sometimes made when a special request comes from a school.) On the second visit, the science advisor usually goes to each room or to those designated by the principal. Often a teacher asks that the advisor visit her. The classroom work is observed, and individual conferences are held with the teachers.

A tentative course of study in science is being prepared at the present time for Grades I to VI. Parts of the course are issued monthly. Two of the advisors

served on a committee with district superintendents and principals to present the teacher's viewpoint in the preparation of the units for this new course. Last fall, grade group meetings were held each month in the different district offices for the purpose of explaining this course to teachers. The science advisor was in charge of the meetings in her district. Specimens, experiments, visual aids, books, and other materials related to the seasonal unit of a particular grade were suggested. The meetings were held after school, and the attendance was voluntary. The groups which assembled indicated that teachers in service are eager to receive suggestions and helps in science-teaching. From 100 to 150 were present at each of many such meetings. Sessions held by small groups at the close of the larger meeting constituted an interesting phase of these gatherings. These small groups had much to add to what had already been given. Teachers recounted to one another their own experience in science-teaching. Many showed great interest in the exhibits and took notes for future use.

One of the most gratifying results of the science advisor plan is that it has provided a channel of exchange through which teachers may give and receive ideas. The science advisor, in the course of her visits, finds many interesting individual procedures, projects, pupil-activities, and special techniques developed in the classroom. She becomes a medium through which these ideas are disseminated. In the individual and group conferences with teachers, she is able to pass on worthwhile procedures which she has observed that are pertinent to the subject under consideration. Sometimes the district superintendent arranges for teachers in neighboring schools to visit the classroom, to see a science assembly program, or to view an exhibit. Thus some of the best work is recognized, and many receive the resulting stimulus and inspiration.

Another means of disseminating worthwhile ideas is by displaying some of the tangible results of classroom work. A seasonal exhibit of science materials and projects is kept in the science rooms in the district offices. An effort is made to show work on the unit in progress or on the unit just completed. The different grades are considered, so that teachers from any grade will find something of interest to them in their particular work. When a group meeting for a certain grade is planned, the exhibit is related to that grade. The materials are changed from time to time, and teachers are invited to come in whenever they can and stay as long as they desire. A typical exhibit for January might include:

A weather calendar showing the weather changes for a month
A homemade weather station
Samples of evergreens with labels
Spatter-prints and blueprints of evergreens
Steps in the process of making spatter-prints
Drawings of trees in winter
Samples of twigs showing leaf scars and winter buds
Winter gardens, blooming bulbs, etc.
Terrarium and aquarium
Winter feeding-stations for birds
Samples of suet puddings
Charts displaying different kinds of fur
Pictures of animal tracks
Animal tracks in clay or plaster
Photographs of pupils' pets
A moon calendar showing phases of the moon
Tin-can star finder
Solar system chart
Experiment showing effects of heat on matter
Tin-can furnace
Display of free materials related to winter units
Reference books and texts

Much interest has been shown in the exhibits. Teachers have been most willing to cooperate by supplying projects which have evolved from their classroom work.

In order that the work may function more efficiently, regular meetings of the science advisors are held with the director of science. Here again an exchange of ideas and suggestions adds enthusiasm to the group, and what benefits one benefits all. The best of what has been seen and done is discussed, and each advisor is able

to carry back to her district renewed interest and enthusiasm.

Last year one of the science advisors, in cooperation with the district superintendent, made a study of teacher-difficulties and types of assistance desired in science-teaching. It was found in this study that the greatest number of difficulties had to do with materials. The type of assistance most desired was teaching-helps of all kinds. This year emphasis has been placed on the use of suitable materials and how to secure them. Developing pupil self-direction in obtaining firsthand information by the use of materials readily available in every district has been stressed as a desirable objective. Through the activities of the sceince advisors and the director of science, many teaching-helps have been provided.

Two of the advisors have assisted the Radio Council in planning the science programs. They have outlined the subject matter, gathered source material, and written some of the scripts. This year there are two science programs each week: the Science Reporter Series for Grades VII and VIII, and the Science Story-Teller for Grades V and VI. These programs are planned so that they are directly related to or supplement the unit in progress in the grade. A growing interest has been shown in the radio broadcasts, and much classroom stimulus has been attributed to the science programs. In connection with the broadcasts, lectures have been planned and given by the Radio Council in places of scientific interest around Chicago. Four pupils from each school are invited to attend the lectures and subsequently to make a report to the class. These lectures have proved of great value.

Another phase of the work which has been further developed this year in the elementary field is closer cooperation with the science museums in Chicago. Lecture tours for the science advisors and for grade groups of teachers were planned by the director of the Field Museum. Lists of exhibits related to each subject in the course of study were prepared. Similar lists in other museums were prepared by the science advisors. Thus the teachers became familiar with exhibits which were of great importance in planning their science excursions. This increased familiarity with the facilities offered by the museums of Chicago has encouraged their use.

Since the science advisor plan was initiated, the status of the advisor has been that of consultant, rendering service and giving assistance to teachers who desire help. It is within her scope only to plan and suggest ways by which the elementary-science program might become a more vital part of the classroom activity. On this basis, a friendly, pleasant relationship exists between advisors and teachers. The attitude of the teachers has been most cordial and gracious to the advisors, and there has been no restraint or diffidence over visits. The results show increased interest and enthusiasm in the elementary-science program.

SCIENCE AND LAND USE

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> Man's life is bound up in the processes of nature; his career, for success or defeat, depends upon the way in which nature enters it. . . . Whatever natural science may be to the specialist, for educational purposes it is knowledge of the conditions of human action.
> —*John Dewey.*

Science is recognized today as a power. To many people it is a thing apart, a remote activity housed in vast laboratories away from the experience of all except great scientific minds. Out of these laboratories tiny streams of facts and principles trickle into high-school textbooks and laboratories, and elementary-science manuals and classrooms. Railroads, radios, airplanes, monumental skyscrapers or glass houses, hard-surfaced highways, great storage dams and reservoirs, contour strip-cropped land, control of soil erosion are wonderful achievements, but the science that produced them continues to be a thing apart from human experience.

The Royal Society of England, the oldest scientific body in the world, had its beginnings when the Cavaliers and Pilgrims were settling the American seaboard. Its original scientific studies grew out of human experiences and the effort to analyze them. Science has traveled a long journey since that time, so that many scientists today do not always perceive that the immeshing web of their laboratory studies reaches into every human hope, interest, and activity.

The only way to bring together these two human poles, the scientist and everyday human experience, one within and the other without the laboratory, is to let science come into the classroom through the medium of experience. Whether this experience leads to a circumscribed circle of thought, and an inflexible, unthinking attitude, or puts one in touch with the community and the world and stimulates creative, imaginative thought, depends upon the discerning vision of the teacher in analyzing the ramifications of human experience into science.

"Science and industry" is a familiar phrase. In the elementary schools children read about the great industries, such as those fabricating iron and steel, automobiles, textiles, petroleum, rubber, or airplanes. When going through one of these plants visitors frequently are taken into a laboratory where samples of steel, rubber, thread, oil, or other materials used in the plant are being tested. It seems a wonderful thing that such a small piece so will reveal the character of the whole mass that immediately the manufacturer knows whether it now is suited to the use for which it was intended, or whether it must be processed and worked yet more. Here is a thrilling, intimate view of industry using chemistry, physics, or engineering in a physical sense.

Education through encouraging a creative imaginative attitude toward science may lead us to discover more of the social and economic—the human—implications of science. It also may lead to a realization of interdependence between science and other fields than industry. Due largely to the fact that science, history, and other fields have been taught as subjects instead of through living and experiencing, people take it for granted that science is one thing; trade, industry, and finance yet something else; and that agriculture is confined to its own cubicle on the land. Today educational leaders and others know that science, trade, industry, finance, agriculture, inextricably are interwoven in the web of life. This means that everyone living in the city has a stake in the land.

"Science and land use" is emerging as an established principle in this opening era of conservation. Therefore, in city and country alike, in teaching for life, through exploring, sensing, and studying the fundamental elements of life, every boy and girl will come to understand his relation to the land if given the opportunity. They will develop an attitude of responsibility for its protection, and a love for it, because out of it springs their well-being. The land is in truth the formation of their very life.

Schools in the largest cities here in the United States are turning their thoughts to the land. Teachers in New York, Chicago, Detroit, Minneapolis, Atlanta, Fort Worth, cities of the Pacific Coast and elsewhere realize that conservation of soil and water, or the reverse, the use to which the land is put, carries to the cities an inescapable influence for good or ill.

Practically every manufacturing industry depends directly or indirectly upon products of the soil. The United States Census reveals the enormous importance of these manufacturing industries. Boots and shoes using leather from animals grazing on pastures and ranges are products of a billion-dollar industry. The manufacture of bread and bakery goods amounts to a billion and a half dollars. The output of butter and of canned fruits and vegetables each approaches the billion-dollar mark. The value of agricultural implements manufactured in any one year is nearly $300,000,000. The flour-milling industry is in the billion-dollar class. Meat packing in some years runs to four billion dollars. Tobacco products are worth about $200,000,000, corn syrup and corn products nearly as much. The product of cotton-goods mills is worth well above $1,500,000,000. Feeds are worth about $400,000,000. Such are some of the great industries employing millions, which have developed because the American people were settling a land of rich virgin soil, and which depend directly or indirectly upon the soil.

The very size of the United States, more than three million square miles (1,903,000,000 acres) in area—about as large as all of Europe—creates exaggerated ideas of the extent of agricultural land. More than half the United States is too high, dry, rough, or rocky for agriculture. Although about half the country is in farms, only about one-half the land in farms is tillable in its present condition. If all these tillable fields were assembled in one place, they would cover only the Corn Belt from Ohio west through Nebraska and south over Oklahoma, Arkansas, Texas, and Louisiana to the Gulf. The other three-fourths of the country, covering all the vast western areas, northern wheat lands, upper lake states, the Southeast, the East, and New England, would be given over to forest, range, or pasture. Thus the tillable acres assume great significance indeed. Their precious topsoil needs to be guarded if the people of the country as a whole are to have a permanent long-time return from it.

But soil erosion already has attacked this fraction of America's most basic resource, the land. More than 400 million acres, or 85 per cent of the tillable land, is eroding or subject to erosion. "Level" land is very small in area. Most so-called "level land" in reality is not level, but has gentle slopes, in many places *long* gentle slopes. This nearly level land is part of our most valuable agricultural resource, but on it wherever there is even a slight slope, water will run downhill, carrying away topsoil. About 200 million acres of good cropland already have been seriously damaged or ruined outright for further crop production.

Many science teachers in elementary and high schools realize the functional relations of science to the land. The Committee on Science Education of the Department of Science Instruction of the National Education Association thinks of science not as a discrete entity, but in its relation to the community, to be taught through the ex-

periences of the child. This approach reveals the intimate connection between the natural sciences, the land, and the soil. It shows what science may contribute to their conservation for permanent human use. Chemistry, physics and mathematics, botany and biology, geography, geology and physiography immediately assume a new and meaningful value to every community and individual.

Ten years ago, the erosion experiment stations of the Department of Agriculture began to measure soil and water losses under various kinds of cultivated crops, types of cultivation, and grasses. They discovered that declining yields and lowering farm returns were due only *in part* to loss of fertility *out of* the soil, and in *large degree* to *loss* of the topsoil over *large areas* of farm land. Between six and seven years ago, for the first time, active measures were taken on a comprehensive scale here in the United States to solve the erosion problem on thousands of acres of farm land. This soil conservation program under the leadership of H. H. Bennett for the first time considered the entire farm and the entire watershed as units to be studied with a view to handling the land according to its best capabilities in the interests of the individual farmer, the community, and the larger social group.

Since this beginning in 1933, within the past few years soil and water conservation practices and a philosophy of considered land use have been applied over millions of acres in the United States. The soil conservation district has been created as a mechanism for the furtherance of conservation, and has taken its place alongside the soil conservation demonstration area in the movement against erosion. The conservation or wise land-use type of farm plan has been developed. Another chapter in the history of American land has been started—a chapter of conservation.[1]

[1] H. H. Bennett. *Report of the Chief of the Soil Conservation Service*, p. 6. Washington, D. C.: U. S. Department of Agriculture, 1939.

The farm or watershed first was surveyed and mapped for degree and length of slope, soil type, amount of erosion, and previous land use. The kind, frequency, and amount of precipitation, whether or not the ground was subject to freezing came into the picture. From these basic facts about the land, land-use plans for each farm or watershed were developed.

Technically trained men are determining the slope of the land and making the maps. They analyze and classify soils as to chemical and mechanical composition, measure the thickness of the original and present topsoil to find out the amount of soil erosion, map the land use, and analyze vegetative cover.

To move from these working facts about the land into carefully considered land use demands information derived from exacting scientific research.

Bennett in his recent book on soil conservation[2] discusses such major elements in soil-conserving land use as agronomic practices, farm and range plants useful for erosion control and water conservation, the place of forestry in soil and water conservation, contouring, terracing, run-off disposal channel-ways and outlets, subsoiling and other subsurface tillage operations, gully prevention and control, control of erosion on highways, water spreading, wildlife and soil conservation, soil conservation and flood control.

Putting these into practice brings many problems to those working on cropland, pasture, orchard and vineyard, range, woodland, and wildlife management. Farmers and technical men cannot and do not solve them except through results derived from experimental science. The sciences used in this experimental science are the same as those of the classroom, such as chemistry, physics, mathematics, botany, geology, soils science, biology, and geography. Consequently, some of the seemingly technical

[2] H. H. Bennett. *Soil Conservation.* New York: McGraw-Hill Book Co., 1939.

strictly agricultural problems are, in reality, science problems that can be thought about in classroom or field as they connect with pupil experience and community interest. Some of these practical problems are:

What rotations should be used on cropland?
How can the organic-matter content of the soil be built up and retained?
What crops and what methods of cultivation should be used on each kind of soil, on long or short slopes under various climatic conditions?
Exactly what are the climatic conditions in each area?
Does the nearest Weather Bureau station provide the required weather and climatic facts?
What kind of grass should be used in restoring pastures and ranges?
How wide should contour strips be under various conditions?
Are terraces needed on a given slope? How many and at what intervals?
Should a slope be put into grass or trees?
Will the proposed practices bring a sufficient reward to justify undertaking them?
How many animals can be put onto a pasture or range?
When should they be put on and taken off?
What wildlife should be encouraged?
How shall it be taken care of?
What vegetation shall be used to control a gully?
How can reservoirs be kept from silting?
How can land use aid in controlling floods?
Will the proposed land use adequately support the farm family?

These problems are the concern of every science teacher and cannot be restricted to agricultural classes. They are functional expressions of the sciences. All science teachers, in elementary and high schools, or colleges, will not see the same correlations between their science and these land-use problems and principles, because they are teaching boys and girls with different characteristics and interests in communities which depend upon the land in a wide variety of ways. But every science teacher should realize that science functions in land use as significantly as it does in industry. They should explore thoughtfully the relations of science to community land-use interests, and, at the same time, recognize the interweaving relation of science, land use, and human life in city and country alike.

The index captions of "conservation" and "land use" reveal only a small area of the functional relations between science, the land, and conservation. Each teacher must use creative, constructive imagination, based on facts, to discover the ramifications of science and of land use and conservation into areas of human life.

Every cultivated area requires moisture. The physics teacher deals with capillarity. One method of determining moisture content of the soil is through a device for measuring capillary tension in the soil. The action of raindrops when striking soil is being studied in connection with soil erosion. The carrying power of water, the suspension percentage and dispersion ratio of soils needs to be studied as part of the process of understanding and controlling erosion. Movement and accumulation of water on slopes of varying length and soil types raises questions in the field of physics and chemistry. Their solution calls mathematics into service. Slopes, soils, vegetation are available to every physics teacher, and from these somewhere in the community may be obtained material and conditions for laboratory experiments either in the classroom or out of doors.

Chemistry has much to contribute towards sound land use. If boys and girls in high school begin to analyze different soils in their own communities and elsewhere, they can compare and contrast soil qualities in relation to value for crops and grazing, and to erodibility. Through these studies they will find out for themselves the difference between a good topsoil and an unproductive subsoil.

The geographer needs to contribute much in the way of detailed climatic and physiographic studies. More needs to be known about characteristics of wind action and rainfall. Botany is turning attention to grasses, studying variations in native types, and the different kinds of grasses for their

suitability for various purposes in different climatic and soil regions. Mathematics takes on a new meaning when called into service in working out practical chemical, physical, climatic, or engineering problems that must be solved if the land is used as it must be, if we are to bequeath it as a rich heritage to children and grandchildren. To those who are teaching and writing texts, land use, soil and water conservation afford a rich field from which to draw vital data tying the sciences more closely to life and living.

The experience realm of young children just beginning school, or even younger, is woven into the land. Nearly every child at some time is intrigued by wild flowers, trees, birds, or fish, and the weather. As the children go through the year they usually observe and talk about the things in their communities that change with the seasons. Fall leaves or fall grasses often attract children. The ground covered with bright-colored leaves brings fairyland to them. But they should not stop with the leaves—they can explore the ground under these bright fall leaves, feel of it, see what it is like, and then, when they discover ground not covered with leaves, do the same, and compare it with the leaf-strewn ground. They may begin to ask what leaves do for the ground, and to become acquainted with topsoil instead of ground. Feeding and studying birds in winter or summer can lead them to find out why we like to have birds in our orchards, gardens, and fields, where birds live, the way in which trees and shrubs which house the birds depend upon soil. Children then would discover how trees and shrubs protect soil from washing, and would discover that birds, trees, shrubs, and good topsoil are all parts of the same story.

Children like farm animals, especially the dairy cow, because it gives us milk and butter. In the past children have studied farm animals as animals and milk-producers, but not as animals feeding upon pastures and living out of the soil. Health and milk-production in cattle depend largely upon the grass in pastures and other feeds grown on the land. Feed value of grass is determined by the soil, the time when cattle are put in and taken out of pastures, and the number of cattle grazed at any one time. Here is another link between the child and the soil.

Children can watch rain spattering on bare and on plant-covered ground, and see what happens. They will find out for themselves the difference between slow geologic and ruinous accelerated erosion. This and many other activities may evolve from everyday experiences and community life.

The most valuable outcomes of this and many other experimental activities for older pupils and small children will be an attitude of interest in the land, and a habit of watching what goes on around them in the soil, on the ground, in the trees, on fields and pastures. They will look upon land and soil as a part of their own life. Such observation and thinking will lead them to love and protect the land, because they will know it provides life and living to each individual and to the nation.

Throughout the country, schools are realizing that the topsoil of the nation has given us food and made possible the cultural and scientific life of each local community and the nation as a whole. They know that every city and country home is rooted directly or indirectly in the soil. Leaders in education are fostering this type of teaching. Dr. John W. Studebaker, U. S. Commissioner of Education, and the staff of the Office of Education are lending thought and influence to bring classroom activities into their true relation with the land. The National Education Association of the United States and the Progressive Education Association definitely are pointing their efforts toward the integration of land use and conservation into core areas of the curriculum. Together they have set up a Commission on Education and Re-

sources whose purpose is to realize this integration of the land and conservation into classroom activities. The Soil Conservation Service of the United States Department of Agriculture and other agencies carrying on the actual physical job of conservation and sound land use are implementing the work of these educators.

Soil and water conservation and land use principles are being treated in numerous commercial texts and government publications suited to practically all age groups. The Soil Conservation Service in co-operation with teachers has prepared material to help teachers, while its bulletins, conservation charts, moving pictures, and lantern slides provide information and material to implement school programs.[3] The United States Office of Education [4] and other federal and state agencies have published material dealing with their own phases of the over-all nation-wide conservation of natural resources.

[3] A list of these publications can be obtained from the Soil Conservation Service, Washington, D. C.

[4] Conservation references available from Office of Education, Federal Security Administration, Washington, D. C.

SOME NEEDS OF ELEMENTARY SCIENCE

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Most educators now agree that if an elementary curriculum is to be fitted to the current needs, problems, and interests of children, it must include some science instruction. But the actual teaching of science in the elementary grades has not become so widespread as has this conviction of its value.

Why does this discrepancy exist? It seems that school administrators are finding the planning and installation of an elementary science program to be fraught with more difficulties than they had expected. Some of these difficulties are those that usually arise when progress is attempted, but others are peculiar to the subject and are ones which science educators and others can relieve or solve entirely.

TEACHER TRAINING

Too few institutions are graduating teachers who are prepared to teach elementary science. Most of the graduates lack an adequate background of the science information that they will need, and they lack training in methods of presenting science to children. Many of the graduates have an academic knowledge, but they lack firsthand knowledge of the behavior and personalities of children (although most colleges have demonstration schools).

It seems that prospective elementary teachers should be given a science program of this type:

(1) The science should be organized around aspects of common environment and modern living, such as air, control of pests, seasonal changes, water supply, *et cetera*. Topics should be omitted if they are of little direct value or interest to the average child, such as the reproduction of microscopic plants, Ohm's law, and pH values.

Scientific principles should be introduced as they are needed in the study of environment and human activities, but the work should not be organized around principles as is traditional in college science.

(2) The science laboratory work should be fitted to the needs of teachers of science in the first ten grades of the public school. It should include the simple demonstrations that are in most elementary and

junior-high-school science programs. It should make use of inexpensive and home-made materials that the teacher may use after she begins to teach elementary science. Tasks such as the determination of specific gravities, detailed drawings of microscopic plants, and precise weighing, should be omitted because they are foreign to elementary and junior-high-school science.

Much of the laboratory work should be done out of doors so that teachers can get some firsthand knowledge of common living things and the relationships between them.

(3) Mathematics should be omitted entirely. The terminology should contain as few difficult scientific words as possible.

(4) The science courses should include a little geology, descriptive astronomy, and chemistry, with some physics, biology, and health work.

TEXTBOOKS

More and better elementary science textbooks are needed. The books should be organized around the interests, activities, problems, and the common environment of children. They should be written so that children can read them; they should use a small vocabulary, few scientific terms, simple sentences, and ideas that a child can grasp. The style should be familiar and matter-of-fact, not stilted or condescendingly childish. The books should not be collections of childish stories about nature; they should be textbooks. And most important of all, the books should appeal to and be interesting to children.

Large pictures should illustrate every idea or thing mentioned in the book that a juvenile reader might not be able to visualize. Illustrations and text should be correlated much more closely than is the current practice.

A complete teachers' manual should accompany each book. Each manual should tell teachers how they can use the textbook to make science instruction function in the lives of children.

EQUIPMENT

Elementary science must now use equipment that is designed and priced for use in high schools and colleges. Simple, inexpensive apparatus, mounts, and charts should be prepared for the demonstrations and topics included in most elementary science courses. Such items should be designed under the direction of teachers in service. Each item should be accompanied by a leaflet, written in simple language, telling how the item can be used effectively in the lower grades.

These elementary science materials should be incorporated in a separate catalogue of about sixteen or twenty-four pages, for most elementary teachers get lost in or overwhelmed by a large catalogue of scientific equipment.

MOTION PICTURES

There is a need for some sound films made for use in elementary science. These films should be built around large elementary science concepts, especially those that are of direct, personal, or social value to the pupils. Not many of them should be just biological studies of the life habits of certain animals.

These films should be real sound films, not just silent films with a recorded commentary by a man with a radio announcer's voice. Apparently children cannot see a motion picture (which usually goes too fast for them) and understand a stranger's speech at the same time, even if he does talk in their own language (which is usually not the case). The real sound accompanying such a film may seem unimportant to a sound engineer, but it will heighten the reality for children and add to the whole situation rather than introduce a foreign element into the situation.

Each of these elementary science films should have a complete teachers' manual which tells teachers ways in which to use

the film to develop certain desirable ideas and attitudes in their classes of little children.

PUPIL NEEDS AND INTERESTS

Those who try to organize programs of elementary science in their schools are badly in need of more information about their pupils. More information is needed about the personal and social needs, interests, and problems of children and the ways in which a science teacher can help satisfy those needs and problems.

A subcommittee of the National Committee on Science Teaching is now working under the direction of W. C. Croxton on this big problem. Skilled veteran teachers in all parts of the nation are working with the subcommittee by recording their observations and ideas on various aspects of this matter.

This is a more important problem than it appears at first to be. It is becoming apparent that the world has changed faster than has the curriculum of the nation's schools, and, therefore, the schools are not doing an adequate job of preparing youth for modern living in the world today. Much of the present standard public-school curriculum is mere dogma that, although possibly of value in the past, now has no direct relationship to out-of-school life and is retained because educators do not know just what to substitute in its place.

Many efforts are being made to modernize curricula by reorganizing their content and socializing the methods of classroom instruction. But it appears that these attempts are not striking at the heart of the problem; educators must consider the needs of the child and not what seems to be wrong with education. A better understanding of the current needs and problems of children, individually and as a social group, will lead the way to the construction of worthy programs of study for schools.

In curricula built upon the findings of such studies of children, science instruction will have a very important role, for things, forces, and changes are much more important now in the daily living of adults and children than they are in the average school curriculum.

Therefore, more information about the current personal and social needs of children will hasten the installation of science instruction in the elementary grades and will enable educators to prepare more easily and successfully programs of science instruction that will be of value to children in elementary schools. Such information about children will also guide teachers so that they can interpret better their courses of study in science and make those courses more valuable to their pupils. Thus, as elementary science teaching becomes more effective and valuable and as elementary science programs become easier to organize (because the underlying principles are more definite), elementary science instruction will become as widespread as instruction in arithmetic and spelling.

SCIENCE IN THE BUD

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At birth the child begins acquiring scientific knowledge of the world about him. I once observed a seven-months-old infant whom I was holding in my arms. It happened that the pale-green silk I wore and her linen dress were of an identical shade. Patiently the baby fingers explored her dress and then mine. She would turn her head to peer intently at first one and then the other, and then would try touching them again. Other things attracted her attention, but at least three times as I held her that afternoon she repeated the experiment. It still came out the same. She had discovered that things that look alike may feel quite different. Scarcely able to sit up alone, unable to form a sentence for at least a year, nevertheless she had—or at least so it seems—asked a scientific question, found the answer, and verified it three times.

As the child's mind awakens, his curiosity intensifies. Any parent of a bright four-year-old will tell you that he can ask more questions in ten minutes than you can answer in an hour. That this curiosity becomes dull and spiritless in later years is probably due in large part to the multiplicity of phenomena crowding increasingly upon him and to his baffling inability to get satisfactory explanations. The "don't bother me, I'm busy" type of response has taught the eight- or nine-year-old to be chary with his questions and often simply not to worry about it. He still cannot help wondering, however, and conducting crude experiments privately, or putting two and two of his observations together to see if they make four. A little encouragement at school and these submerged questions come popping out, often very pertinently.

One precious thing about science in elementary grades is its flexibility. The course of study is not fixed as in arithmetic or spelling. Doubtless some rigidity is highly necessary in secondary-school science, but in the lower grades we may take advantage of whatever comes up; we may stop by the way and investigate; we are undoubtedly going somewhere in the course of study, but we are in no hurry about it. This leisurely and spontaneous method of learning opens up an amazing number of leads and spurs to an active curiosity that should make a delightful approach to many points of contact later in secondary-school science.

It is surprising what an amount of scientific learning may ensue from one small impromptu experiment. A group of third- and fourth-grade children who had made a study of pioneer life was assigned a work-type reading lesson about early methods of telling time. The teacher had assigned the same lesson to various classes many times without any great scientific value resulting, but these children wanted to make a water clock like the one they read about. A part of the children's written report follows:

> Vivian and Patricia brought halves of orange skins. We punched pinholes in the bottoms. We put them in water, but they would not sink. We thought there was too much oil in the skin and too much air. The orange peel was too light. Next day Helen brought half of a hollowed-out potato. Vivian brought a small can. We punched holes in these. We put the potato in water at 1:19 P.M. It did not fill. Helen made a bigger hole at 2:38 P.M. It sank at 2:42 P.M. It filled in four minutes.

The children decided that the weight of the potato "pressed the water up into it" too fast. Since the potato was also difficult to balance, they concentrated on the can. They were trying to get it to sink in exactly one hour. Their report continues:

> We put the can in water at 1:21 P.M. It sank at 1:27 P.M. The hole was too big. We

put a pin in it. We put the can in water at 1:30 P.M. It sank at 2:30 P.M. The children were watching it. We all clapped and cheered. Since then we have tried many times. It did not work again. It is hard to make a water clock work exactly right.

An enumeration of some of the learning-values of this experiment follows, the correlation with reading, language, and arithmetic being evident:

1. Intensive purposeful reading. They went back to the book several times before they really understood the water clock. Later, when the orange bowls failed, they found that they had forgotten the material of the original bowl (brass) and they consulted the book again. They then reasoned out something of the effect of weight and the relation of the size of the hole to it. This led to some conclusions about their failure with orange skins.

2. Practice in reading the clock exactly, both before and after the hour.

3. Practice in writing time correctly for both morning and afternoon. For three days they kept time records of their experiments.

4. Practice in finding differences in time mentally and on paper.

5. Stimulation of ingenuity in the face of failure. They tried successively orange halves, potatoes hollowed, several tin cans, clips and bobby-pins for balancing, pins and toothpick fragments for reducing oversize holes, and more or less water to float the "clock."

6. Analytical reasoning about failures, as shown by these expressed hypotheses:

(a) The orange skin is full of air holes and too ligl.t.
(b) The orange skin has oil in it which may prevent the water from entering.
(c) There may be an air or oil bubble in the hole.
(d) The hole may be too small, or vice versa.
(e) A round bowl is easier to balance than a flat one.
(f) A bent pin may work better than a straight one. (It did, but the toothpick floated.)

7. Courage and patience to keep on trying. The experiment would have continued for more than three days if it had not been stopped.

8. Stimulation to individual attempts. They gave up orange bowls when Charles reported that he had tried them at home and they would not sink when full of water.

9. Appreciation of the slow growth of a delicate mechanism like a timepiece from crude beginnings by means of patient experiment.

10. Discovery of surface tension. This delighted them utterly. They never tired of watching the "slope" down to the can about to submerge. They assembled what data they had. They remembered water bugs, leaves floating, etc. They wanted to know if "that cold feeling you get in swimming just where the surface touches your skin" is due to surface tension.

11. Several new terms.

12. Language experience in writing the story.

13. Discrimination in selecting important data to include, and unimportant to exclude.

14. The satisfaction of success. Amazingly enough, one can sink in exactly one hour, which is what a water clock should do. One would have thought that Minnesota was just about to make the winning touchdown. They hung over their can with one eye on the clock, "rooting" for it with all their might, fiercely ordering each other not to jar the desk in the least, till the minute clicked and the can sunk. They have described the ensuing outburst very mildly.

Powers notes among the traits to be developed by science teaching:

> Careful and critical methods of thinking . . . ability to select data relevant to a problem; to evaluate their own conclusions; to hold suspended judgment . . . respect for objective evidence. . . .[1]

It would seem that in an elementary way the water clock experiment has stimulated some of these traits. That there is a

[1] Powers, Samuel Ralph. "Improvement of Science Teaching." *Teachers College Record* 40: 279; January, 1939.

greater need than ever before for all of us, even for young children, to be able to do this kind of thinking is evident to anyone who merely reads the current magazines or listens to the radio.

Miss Melrose says that the scientifically trained child is different:

1. Through an understanding of the forces, phenomena, processes, materials and living things that interact to produce the world in which we live.
2. By development of the scientific attitude.
3. By training in the scientific method of thinking.[2]

Meister,[3] while noting that science is stepping down farther into the elementary grades, stresses the social and economic aspects of science, pointing out especially that "war is bad science" and that "prejudice is unscientific." All too well we are beginning to know the evil uses to which propaganda may be put in swaying the gullible. Whether this giant force may be in future a potential for good or bad depends upon how we receive it—whether with the unbiased attitude of the scientific thinker, or with the quick prejudice of the easily swayed. Democracy itself may depend upon our attitude.

The most vulnerable of our population is that group which for economic or scholastic reasons is unable to reach high school. Its votes are as good as those of the college-professor group and more numerous. Would not some training in scientific thinking in the elementary school be good for this group?

Propaganda has reached down, down even into the kindergarten. Shall we not teach our five-year-olds to "hold suspended judgment" when told that "Strong-Arm Kiddie" breakfast food will give them muscles like Tarzan's and to wait for objective evidence that no other breakfast food will do as well? Shall they not inquire within themselves whether they are drinking "Quart-a-Day Milk" because the dairy is clean and sanitary or because for fifty bottle caps they can join the "Junior Wranglers' Club" and get a cowboy lariat? Surely an "ability to select data relevant to a problem" would be of use here.

Since the young child is interested in scientific phenomena and their significance, since he is able to reason and generalize in simple ways, and since the demand for a scientific attitude in our thinking seems more important than ever before, even among children, does it not follow that the bud of science should be allowed to develop a little more rapidly?

[2] Melrose, Mary. "The Need for a Twelve-Year Science Program for American Public Schools: II. From the Viewpoint of Experimental Schools in City Systems." SCIENCE EDUCATION 20: 55; February, 1938.

[3] Meister, Morris. "The Program for Science in 1950." *School Science and Mathematics* 39: 103–116; February, 1939.

LET US TEACH SCIENCE

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What exactly is science? Science is a method of making discoveries so superior to all others that it would be almost fair to call it the method of making discoveries.

The human race is perhaps 1,000,000 years old, but it took man 900,000 of those years to discover that he could chip stones into rough, sharp fragments for weapons. Thus he passed from the "tooth-and-claw age" into the Old Stone Age. In 90,000 years more, he discovered that he could improve these chipped stone weapons by grinding and polishing them. In 5,000 years more, he discovered a few metals and reached the stage about which we read in ancient and mediaeval history. Only about 400 years ago did he discover a highly successful method of discovering, and enter upon our modern age of science. Every year now there are more discoveries than in the 1,000,000 or so years of pre-scientific history!

The method of discovering is the method of science. It is commonly called "the scientific method." In spirit and in fundamental procedure it is simply this: Don't believe all that others tell you, or what you read, or even what seems reasonable, but investigate and find out for yourself.

Are there spots on the sun? Look through smoked glasses and see!

How do crickets sing? Approach one very slowly and quietly.

How do frogs catch their food? Tempt one with a fly on a split broom-straw.

Do cactus plants need watering? Try raising different samples of the same kind, with and without watering.

Which is more healthful, white bread or whole-wheat bread? Try raising two groups of white rats or mice, one on white bread and milk, the other on whole-wheat bread and milk.

Why does a certain boy have a headache every Sunday? (Here one must guess at the answer and then see whether the guess is right, just as when one looks up the spelling of a word in the dictionary.) We might guess that he stays up too late Saturday night and have him try going to bed at his usual time to see whether doing so solves the problem. Or we might guess that the Sunday paper causes the headache, or the late dinner, or something else, and have him try changing that one particular habit to find out whether that is the difficulty.

Personal and original problems often call for considerable ingenuity and are opportunities for genuine discovery in which the pupil chooses the paths he will explore first and the ways in which he will explore them. The procedure is like scouting.

And, like scouting, the method of making discoveries cannot be mastered by memorizing discovered facts. Like scouting, one cannot learn it in any real sense merely by being told about it. Pupils must learn how to make discoveries by making discoveries for themselves, and skill in making discoveries is acquired by practice, like any other skill. Scientific attitudes and other scientific traits grow in one-who-finds-out-things-for-himself.

If we teach science itself, we shall in time become far more scientific than many an author of science readers, texts, and books about the products of science. Our teaching will be genuine and valuable. Our activities—exploring, discovering, creating—will result in growth, progress, and fun, and will be as enriching to ourselves as to our pupils. Let us try it.

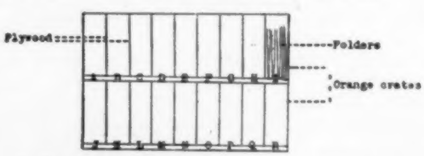
Classroom Notes

Picture File.—With the advent of large-sized magazines devoting the majority of their space to pictures, a new problem is presented to the classroom teacher. The standard file holding 11 in. by 8 in. folders is not large enough for many pictures. Those pictures measuring more than 11 in. by 8 in. are often the type that are spoiled by folding. Picture files from commercial companies are expensive.

A simple file that can be used for any size picture can be constructed as follows:

1. Buy manila envelopes of any size you wish from a stationery or ten-cent store.
2. Build a cabinet of orange crates.
3. In the cabinet insert plywood boards to section it horizontally.

The pictures can be filed in the folders and the folders slipped into the sections. The sections may be labeled alphabetically or by subjects. More cases may be built as the file grows.



Soilless Gardens.—The new interest and enthusiasm that people are manifesting in growing plants without soil makes a study of them interesting in elementary science classes. Complete sets and directions for growing plants without soil can now be obtained for $2.00 from the Chemical Publishing Company, New York City: Maltin, D. R. *Growing Plants without Soil.* Waterproof boxes can be made by the boys in the class at home or in the shop.

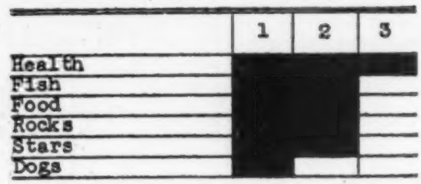
Current Happenings in Science.—Many teachers encourage students to bring clippings from the newspaper about science. These are often reported on or placed on the bulletin board. It is also interesting to keep a chart of the number and kinds of articles appearing daily in the local newspaper. The chart may be made as follows:

Science in the Newspaper

	Jan. 1	Jan. 2	Jan. 3
8			
7			
6		Fish	
5		Fish	
4	Stars	Food	
3	Dogs	Food	
2	Rocks	Stars	Health
1	Rocks	Health	Health

Each child may enter his clipping on the chart each day. At the end of a week or a month a chart can be made showing the kinds of science articles that have been printed in the local paper.

Science Articles in the Newspaper



Making a Time Clock.—The concept of geologic time is difficult for boys and girls to understand. A device to aid students in clarifying the amount of time involved in the various phases of the earth's history is a twelve-hour clock which the students can construct. The clock is made in the following manner:

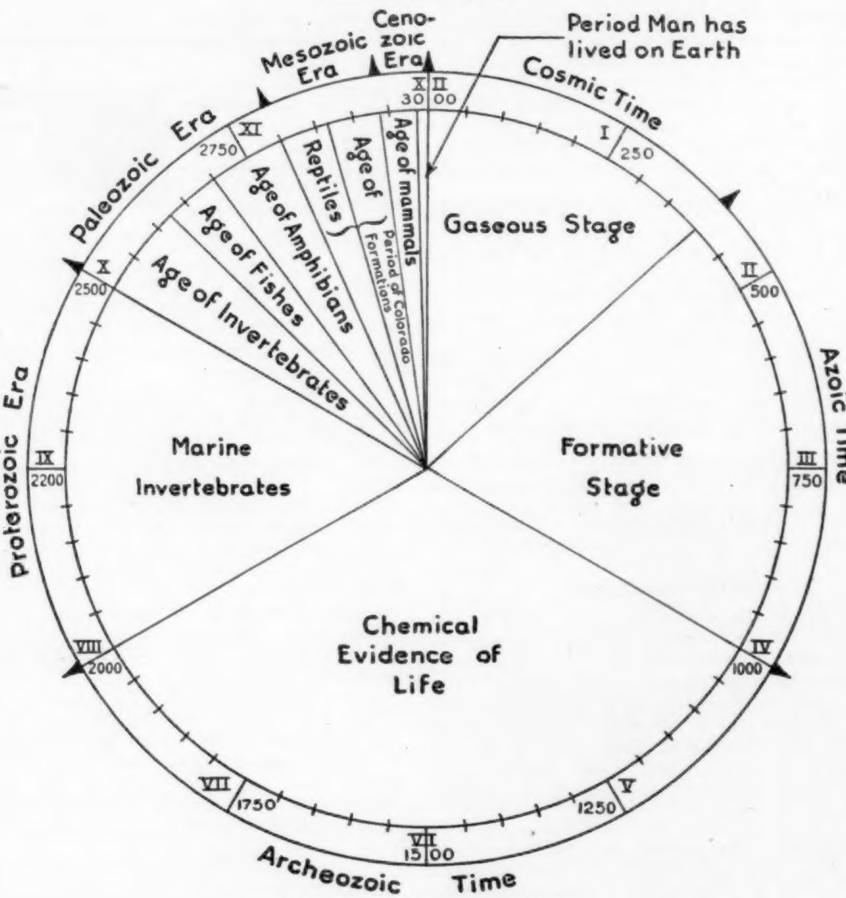
1. Construct a 7-inch circle on plain white paper. (See page 162 for complete chart.)
2. Construct a 6½-inch circle inside the first.
3. The space between the first two circles represents a clockface. Within this space will be indicated the hours in Roman numerals.
4. Divide the second circle into twelve equal parts. Draw a line to the first circle. These lines represent the hours. Indicate the hours by Roman numerals.
5. One estimate of the earth's age is 3,000 million years. Each hour would then represent 250 million years. These figures may be placed by the Roman numerals.
6. Divide each hour into five sections. Each section will represent 50 million years.
7. The phases of the earth's history may then be easily computed on the time clock and lines drawn from the second circle to the center. These divisions can then be labeled and colored.
8. A suggested list of divisions follows:

(1) Gaseous stage
(2) Formative stage
(3) Earliest life
(4) Age of invertebrates
(5) Age of fishes
(6) Age of amphibians
(7) Age of reptiles
(8) Age of mammals

Building a Home Library.—Many students would like to have private science libraries but cannot afford to buy books. Teachers may help them build an inexpensive library through the use of many commercial firms who are printing accurate, interesting booklets on a wide variety of science subjects the whole family would enjoy reading. A list of some of the most outstanding publications is given below. These may be secured in any quantity from the company listed.

Animals:
The Sinclair Dinosaur Book (Sinclair Refining Company, 45 Nassau Street, New York City).
Aviation:
The Story of the Airship by Hugh Allen (Goodyear Tire and Rubber Company, Akron, Ohio).
Wings over America (National Recreation Association, 315 Fourth Avenue, New York City).

GEOLOGIC TIME CLOCK



Adapted from Reed's *The Earth.*

Clothing:
- *The Romance of Cotton* (California Cotton Mills Company, Railroad and Kennedy, Oakland California).
- *The Boy Who Pegged Shoes* (Douglas Shoe Company, Brockton, Massachusetts).
- *The Story of Cotton Thread* (American Thread Company, 260 West Broadway, New York City).

Communication:
- From American Telephone and Telegraph Company, Information Department, 195 Broadway, New York City:
  - *Birth and Babyhood of the Telephone.*
  - *Telephone's Message.*
  - *Magic of Communication.*
  - *Telephone in America.*
- From Western Union Telegraph Company, 195 Broadway, New York City:
  - *How Cablegrams Are Sent and Received.*
  - *How Telegrams Are Sent and Received.*
  - *Short History of the Westen Union Telegraph Company.*
  - *The Yellow Blank.*

Diamonds:
- *Diamonds, Their History and Romance* (Virgin Diamond Syndicate, 500 Fifth Avenue, New York City).

Food:
- *The Story of Bread* (International Harvester Company, 606 South Michigan Avenue, Chicago, Illinois).
- *The Story of Coffee* (American Can Company, Home Economics Department, 230 Park Avenue, New York City).
- *The Story of Salmon* (American Can Company, Home Economics Department, 230 Park Avenue, New York City).
- *The Hawaiian Islands and the Story of Pineapple* (American Can Company, Home Economics Department, 230 Park Avenue, New York City).
- *Facts About Chewing Gum* (American Chicle Company, 30 Thomson Avenue, Long Island City, New York).
- *The Story of Sugar* (American Sugar Refining Company, 120 Wall Street, New York City).

Health:
- *Dentistry and Public Health* (Bureau of Public Relations, American Dental Association, 212 East Superior Street, Chicago, Illinois).
- Colorado Tuberculosis Association, 305 Barth Building, Chicago, Illinois:
  - *Robert Koch.*
  - *Landmarks of Progress.*
  - *Laennec, the Listener.*

How Safe Is Home? (Metropolitan Life Insurance Company, New York City).

DONALD G. DECKER,
Laboratory Schools,
Colorado State College
of Education,
Greeley, Colorado.

Experience in the Classroom.—In the junior high school, children are most interested in experiments and activities where they can make things than they are in any other type of activity. Many of the children have never had elementary science, and are intensely interested in doing experiments.

When we were studying communications, the children wanted to know about sounds and what made them. Tuning forks were used to show vibration of sound; and after the fundamentals of sound had been studied, the children made a variety of musical instruments. Some of these were xylophones; chimes made with bottles, tumblers, and water; guitars; violins made from cornstalks; and many others.

Simple telegraph sets were made, and messages were sent from room to room. In some instances they were used to send messages from home to home.

In studying foods, we found again that experiments were received by all with enthusiasm. Simple food tests were found and performed by children at home. These were the iodine test for starch, the burning test for protein, and the glazed-paper test for fats.

Each child had an individual food problem of his own choice. The children wanted to make something in school which had some connection with the food they had chosen. For example, the child who studied wheat wanted to make bread. This was impossible because of lack of equipment. At the suggestion of the principal, the child baked the bread at home, brought a sample and a note from her mother saying that she had baked the bread herself, and received credit.

Panel discussions and debates are an important part of the schoolwork. The children present very convincing arguments and enjoy this type of work.

Many of the children, after reading, do not like to express their ideas in simple words but want to use more difficult, scientific words. This is interesting to me and keeps me busy helping them find words that are difficult and still understandable to the students.

BURLENA LEE SOOTS,
Scottsbluff, Nebraska.

Migration of Birds.—During a discussion of the problem "Why Do Birds Migrate?" the group wanted to keep some record of the birds they saw. A bird clock was suggested which proved very interesting to the group. A large clockface was made of cardboard, each hour of the day representing one month of the year. A "hand" made of cardboard indicated the month. Each child who saw a bird during that month reported it to the group, giving a description of the bird and telling some interesting thing about it. A picture of the bird was pasted on the cardboard under the month. At the end of the school year the children could tell from the bird clock the birds that were permanent, the birds that were winter, spring, or summer residents, and the birds that were transient visitors in the locality.

Magnetism.—During our discussion of the field of force of a magnet, the group demonstrated a magnetic field by means of iron filings and then made blueprints of the magnetic fields of various magnets. The group sprinkled small handfuls of iron filings on pieces of blueprint paper and held the papers over horseshoe, U-shaped, and bar magnets. The papers were tapped lightly; the iron filings so arranged themselves as to show the lines of force in the magnetic field. The blueprint papers were then put in strong sunlight for several minutes, then removed and dipped in cold water. After they were dried, the lines of force were visible on the paper.

To motivate a unit problem in the third grade on "How Does a Magnet Work?" various kinds of magnets were placed on tables, together with boxes containing thumbtacks, rubber bands, pins, corks, etc. When the children came into the room, they were told to play with the articles placed on the tables. After several minutes of playing, the children took a very active part in discussing observations they had made. Many problems were raised. The group was eager to find out more about magnets.

Posture.—In our school, health is combined with our science course. When studying the problem "Why Must I Have Good Posture?" the group made suggestions to the boys and girls, telling each in the class how he or she might improve his posture. Suggested exercises were given to each individual, and were carried out during the physical education class.

Watching Plants and Animals Grow.—In the autumn, while studying how living things grow, we found it very satisfactory to keep live insects in various stages of growth in our science room for observation, carrying on the following procedure: We grew plants which the insects used for food. When the plants had grown several inches, we placed lamp chimneys over the plants, put the insects that fed on that kind of plant in the lamp chimney, and placed a small piece of screen over the top. Many interesting observations were made concerning growth of animals as well as plants.

"Movies."—In summarizing the conclusions arrived at during the study of the problem "How Can We Tell How Old the Earth Is?" the class put on a "movie." Each member of the class was responsible for one or more drawings representing one of the problems discussed. A large cardboard carton was used for the "movie" picture box, and two broom handles were used as rollers for the "film." As the pictures were

shown, each child told the story of the drawing he had made.

Checking Up on Sanitation and Safety.—During the study of the problem "How Can We Make Our Community a Better Place in Which To Live?" the members of the sixth grade made a sanitation and safety survey of the school as well as of their homes. Suggestions for improving the school and home were given to the students, parents, and superintendent.

Free Selection of Science Problems.—One sixth grade group asked whether they might each study some problem in science in which they were particularly interested. Each student selected a problem, analyzed it, and solved it by experimenting, observing, interviewing, making models and drawings, and reading. After six weeks of study, each member of the class presented his problem to the class and summarized his findings. The results were very satisfactory.

Bulletin Boards Indispensable. — I have found bulletin boards indispensable in the teaching of science in the elementary school. I use them as a means of motivating problems, giving information on problems, and summarizing problems. Sometimes I use pictures, and sometimes words, phrases, or statements that have been printed.

RUTH LIPPBERGER,
Sergeant School,
Monte Vista, Colorado.

Making Evergreen Wreaths. — Evergreen wreaths for Christmas decorations can be made easily by children in elementary schools. The materials needed can be supplied with little expense. A coil of heavy wire for making the frame; a spool of light pliable wire, such as number 22 copper wire or a spool of florist's wire for fastening greens; wire cutter; pruning shears; evergreens, such as fir, cedar, hemlock, and spruce; and decorative materials, such as pine cones, fruit, or berries are all of the materials needed for making attractive Christmas wreaths.

First, cut off as much heavy wire as is necessary to make a wreath of the desired diameter. Fasten the ends of the wire securely by overlapping and twisting them so that they cannot pull apart. This ring should be heavy enough to support the weight of the completed wreath without sagging and yet pliable enough to bend into shape.

With pruning shears cut shapely sprays of evergreen not over six or seven inches in length. Select sprigs with good full tops. Arrange them in bunches. If a mixed wreath is desired, use sprays of various kinds of evergreens. Select a point on the frame to be used as the top. At this point bind a bunch of greens to the frame with light pliable wire. Hold the evergreens so that the stems point toward the center and the tips towards the outside of the wreath. Bind a second bunch of evergreens to the frame. This time hold them so that the tips point toward the inside and the stems to the outside of the wreath. Then, well under the tips bind another bunch of greens holding them in the same position as the first spray. In this way continue binding small bunches of evergreens to the frame until one side of the wreath is completed. Be sure to keep a good overlapping of ends and pull the wire tight so that the evergreens will be held in firm position. This work can be done best on a flat surface, such as the top of a table. All materials should be kept some distance from the wreath so that its fullness and shape can be judged. Hang up the half completed wreath, stand back, and evaluate your work.

Then make the second half of the wreath as nearly like the completed half as possible by wiring bunches of greens to the frame. Hang up the wreath and study it for width, symmetry, and fullness. Small bunches of greens may be wired in the wreath to fill in thin places and to hide exposed stems. Clip the wreath into shape by cutting off any protruding ends or lop-sided effects that spoil the clear outline. If the work has been done carefully, the result will be a full attractive evergreen wreath.

For color accent on this green base, one's artistic tastes can run almost rampant. Decorations that give color and attractiveness are bayberries, bitter-sweet, holly berries, pyracantha berries, fruit, and pine cones.

A recent vogue is the fruit or Della Robbia wreath. Della Robbia wreaths are made on a plain evergreen background similar to the one just described. Small pale lemons, tangarines, kumquats, small red apples, and bunches of tokay grapes are wired into the evergreen background. Short lengths of pliable wire are run through the fruit or wound around the stems and twisted tightly. The two free ends should be long enough to fasten the fruit on the background. Arrange the fruit in clusters keeping the heaviest at the top.

Another method of using greens and color accent in wreath-making is commonly called "the picking method." In using this method, the wreath maker is dependent upon the florist for materials, such as a mossing ring, some florist's hairpins, and a bunch of picks. The mossing ring is made of sphagnum moss covered with wax paper, cellophane, or cheesecloth. Sprays of evergreen cut five to six inches long are attached securely to the end of a pick by wire that is fastened to the pick. The "picked" branches are pushed into the moss ring. From this point on the procedure is the same as in making a wreath with a wire background. This method is somewhat faster than the wire method. On the other hand, it demands certain materials that may not always be available and for this reason is not as applicable for use in the classroom as the wire method.

BURWELL C. RYCHMAN,
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Editorials and Educational News

MEETING OF THE NATIONAL COUNCIL ON ELEMENTARY SCIENCE

The twenty-first annual meeting of the National Council on Elementary Science, which was held on Saturday, February 24, 1940, in the Crystal Room of the Jefferson Hotel in St. Louis, was well attended.

Dr. Craig and Dr. Robertson, in their discussion of emerging methods and curricula in the elementary school, were so direct, so emphatic, and so convincing that they held the audience for the entire morning.

At the afternoon meeting, Dr. Caldwell presented a stimulating address regarding elementary science for different ability levels. He enlivened his analytic discussion with many concrete illustrations and applications.

The last paper, but not that of the least interest, given by Dr. Florence Billig, was rich in suggestion for the science teacher in her use of research.

The business meeting followed the program.

The following officers were elected:

President, Miss Jennie Hall
Vice President, Francis D. Curtis
Secretary-Treasurer, M. L. Robertson

Otis W. Caldwell was elected to the Board of Directors for a term of five years.

It was voted that the fiscal year begin with each annual meeting and end with the following annual meeting.

It was also voted that the N.C.E.S. join the American Science Teachers Association, with one Director.

Miss Nellie Matlock and Mr. L. M. Dougan of the St. Louis Schools were given a vote of thanks for their assistance in making the arrangements for the meeting.

TRAVEL FIELD COURSE

During the summer session of the School of Education of Western Reserve University, a field course is offered for teachers. The course is designed to give teachers background and firsthand information on such subjects as forests, grasslands, alpine regions, glaciers, gold mining, the fishing industry, and lumbering, etc. Emphasis is given to the ecology of the areas visited. Teachers will have an opportunity to gain concrete experiences in certain areas of natural science.

The itinerary includes such national parks as Zion, Bryce, Grand Canyon, U. S. Grant, Sequoia, Mount Rainier, and Glacier. Other points of interest will be Salt Lake City, California, Portland, and Seattle. From Seattle the itinerary includes an Alaska cruise with stops at such forests as Ketichekan, Juneau, Seward, and the new Metanuska colony.

The air-conditioned Pullman and the delightful sailing in the Alaska waters help to make the field cruise both educational and recreational. Those wishing information concerning the field course may write to Ellis C. Persing, Western Reserve University, Cleveland, Ohio.

CONSUMER EDUCATION CONFERENCE

A regional conference on consumer education will be held on the campus of George Peabody College for Teachers on Friday and Saturday, May 17 and 18, 1940. The major themes include a consideration of basic questions in consumer education and current practice in consumer education.

There will be two general sessions which will include addresses by John Cassels, Institute for Consumer Education, Stephens College, Columbia, Missouri; Edna J. Orr, Alabama Polytechnic Institute, Auburn, Alabama; J. J. Oppenheimer, University of

Louisville, Louisville, Kentucky; James E. Mendenhall, Institute for Consumer Education, Stephens College, Columbia, Missouri; Gordon McCloskey, Alabama College, Montevallo; and Leland Gordon, Denison University, Granville, Ohio. The dinner meeting will be addressed by Donald Montgomery, Consumers' Counsel Division, Agricultural Adjustment Administration, Washington, D. C.

On the afternoon of Friday, May 17, the conference will divide itself into seven discussion groups. The topics and discussion leaders of these groups are as follows: Elementary Education, Reign Hadsell, Consumers' Counsel Division, Agricultural Adjustment Administration, Washington, D. C.; Rural Schools, Maurice Seay, University of Kentucky, Lexington; Science and Mathematics, S. E. T. Lund, University of Tennessee, Knoxville; Social Studies and Home Economics, Rufie Williams, Institute for Consumer Education, Stephens College, Columbia, Missouri; Business Education; College Economics, G. W. Phelps, University of Chattanooga, Chattanooga, Tennessee; and Adult Groups, Elizabeth L. Speer, University of Tennessee, Knoxville. The members of the panels will include outstanding leaders in their respective fields of consumer education.

Since this is the first conference of its kind in the southeastern region, a representative gathering of teachers and others interested in consumer education is expected. The conference is being conducted in cooperation with the Institute for Consumer Education at Stephens College.

AUDIO-VISUAL SCHOOL AIDS

The 1940 edition of "Audio-Visual Service for Schools," a widely-read presentation of sound products and services developed especially for educational use, has been announced by Ellsworth C. Dent, Director of the RCA Victor Educational Department.

Presenting radio and related equipment of a wide variety, the booklet is being distributed to thousands of educators throughout the country, and may be obtained without cost from Mr. Dent's office at Camden, New Jersey.

Equipment designed to aid classroom instruction and extracurricular activities, as well as general administrative problems, is illustrated and described. Emphasis is placed on practical applications, rather than on lengthy technical descriptions of the equipment. New radio and Victrola instruments, instantaneous recorders, sound amplification systems, two complete sound systems providing radio and Victrola reproduction, and a new 16-mm. sound motion picture projector are shown.

"Audio-Visual Service" opens with a brief history of RCA Victor's 30 year background in bringing schools the benefits of recorded aids to instruction. It is pointed out that recent advances in electronic engineering have placed at the disposal of schools a vast number of additional teaching aids. Accordingly, brief information concerning laboratory and test equipment and U.H.F. (ultra-high-frequency) broadcast and receiving equipment is included.

JUNIOR COLLEGE MOVEMENT

Enrollment in junior colleges in the United States has doubled in the last seven years, according to the 1940 Junior College Directory, just issued by the American Association of Junior Colleges.

Enrollment has increased from 155,588 to 196,510 in the last year. This 41,122 increase, which is 26.4 per cent, is the greatest ever reported, according to Walter C. Eells, secretary of the association. There are now 575 junior colleges, as compared with 556 reported a year ago.

California leads the nation, with 64 junior colleges enrolling 73,669 students. Other leading states are:

Texas	40	12,804
Iowa	36	3,409
Oklahoma	29	5,394
Missouri	24	7,831
Kansas	24	5,398
Illinois	23	14,711
Pennsylvania	23	3,246
Mississippi	21	4,645
North Carolina	21	4,592
Georgia	20	5,925

A junior college, it is explained, is one which does work of college or university grade for two years beyond high school. Twenty-seven of these institutions include also, however, the last two years of high school. The largest junior college is the San Bernardino Valley Junior College in California, which has 8,317 students. This number includes 7,499 special students, most of whom are adults. An extensive adult education program is offered by eight California junior colleges. Los Angeles City College, with 6,687 full-time students, has the largest full-time enrollment of all junior colleges in the country.

There are 33 junior colleges in the country with enrollments of more than 1,000. The size which is most general is between 100 and 200, in which group there are 153 reported. There are 212 junior colleges with enrollments between 200 and 1,000. The average for all is 349.

GARDEN EDUCATION

Gardening is beginning to receive some of the attention it deserves, as a means of wholesome adult recreation and as a means of effective education for children.

The Garden Education Department (formerly the School Garden Association of America) of the National Education Association of the United States is now publishing as its official journal, *Garden Digest*, a newly enlarged and improved garden publication. The subscription rate is $2.00 a year.

The educational philosophy underlying the endeavor is that gardening is education—that gardening can be made to serve as an effective aid in teaching pupils the standard subjects and in building character, citizenship and wholesome avocational interests.

With the hopes of the new journal we agree and lend our best wishes. At the same time, we express the desire that the new organ will seek to give its readers science meanings, scientific ways of approaching real problems, and something of the attributes of the scientific attitudes—and thus be a medium of education for more democratic living.

APOLOGY

In the January, 1940, issue, we published an interesting science play, under the title, "Science Writes a Play." This play was written by the students at New Mexico Normal University, Las Vegas, New Mexico, and, as we indicated in a footnote on page 36 of the January issue, was evaluated by A. M. Poole, Critic Teacher of Science, and Nell Doherty, Critic Teacher of English. Our sincere apologies for omitting the name of the institution.

Abstracts

ELEMENTARY SCIENCE

PALMER, E. LAURENCE. "Teachers Number." *The Cornell Rural School Leaflet* 33:3–63; September, 1939.

The first article in this number, "Teaching Geography Through the Study of Mammal Distribution," by E. L. Palmer and Edna Drill emphasizes the theme for the 1939–40 Leaflets which is *Conservation*. This illustrated article describes various orders of mammals and the geographical and political areas in which the particular order is found.

Other articles in this Leaflet are: "Nature Study, The Foundation of Sex Education in Home and School" by Maurice A. Bigelow, and "From Egg to the Chick" by Alexis L. Romanoff. The latter article has four illustrations and nine plates in color.

—C.M.P.

PALMER, E. LAURENCE. "Farm-Forest Facts." *Cornell Rural School Leaflet* 33:3–32; November, 1939.

The following phases of farm-forest relations are discussed: (1) the forest, (2) forest foliage, (3) forest floor, (4) forest fires and frightfulness, (5) forest flowers, (6) flying friends, foes, fungi, (7) furs, (8) feathers, (9) flesh, (10) floods, (11) fish, (12) fun, (13) fables, fads, and fears, (14) food, (15) famine, (16) fuels, festivities, (17) fiber and furniture, (18) future forests, (19) finance, (20) famous foresters, and (21) fossil forests.

—C.M.P.

PALMER, E. LAURENCE. "Fields in Winter." *Cornell Rural School Leaflet* 33:3–32; January, 1940.

This Leaflet continues the series dealing with the use of various kinds of farm lands, particularly as they bear on wild life. The various divisions are as follows: (1) Snow banks and bare ground, (2) The plant's job, (3) Fence row and rock pile, (4) Weed patch and road cut, (5) Going places, (6) Keeping warm and safe, (7) Rabbits and wood-chucks, (8) Skunks, foxes, dogs and cats, (9) Deer, mice and shrews, (10) Hawks, owls and crows, (11) Pheasants, sparrows and quail, and (12) Junior Conservationists' page. Numerous illustrations are used, presenting some ideas that are scientifically correct and others that are intentionally false.

—C.M.P.

BLOUGH, GLENN O. "Learning about Our Plant Neighbors." *The Instructor* 48:47–56; September, 1939.

Phases of this unit are adaptable to each of the following grade levels: primary, middle, and upper grades. The primary unit is entitled, "Where Do Plants Come From?"; the middle grade unit, "How Do Plants Change with the Seasons?" and the upper grade unit, "How Are Plants Affected by Environment?" Objectives, problems, bibliographies for pupils and teachers, pupil activities, and general discussion are included in each unit. —C.M.P.

BLOUGH, GLENN O. "Light and How It Helps Us." *The Instructor* 49:45–54; January, 1940.

Objectives, problems, things to do and activities, pupil bibliography, and teacher bibliography are included for the primary grades, for the middle grades, and for the upper grades. The primary grade unit is entitled "Where Do We Get Light?" the middle grade unit "How Does Light Travel?" and the upper grade unit "How Do We Use Light?" There are three pages of photographs: (1) The Story of Home Lighting, (2) Some Instruments That Use Light, and (3) How Light Behaves. —C.M.P.

SIMMONS, MAITLAND P. "Model of a Mountain." *New Jersey Educational Review* 13:97; December, 1939.

This article describes a pupil project in general science, and the values that accrue to such projects. It is probably true that such activities should form a more integral part of science classwork than they usually do. —C.M.P.

HERZ, L. ERNEST. "Experiments with Plants." *Science Guide for Elementary Schools* 5:1–46; March, 1939.

In this Bulletin, twenty-six experiments are devoted to reproduction and spread of plants, two on plant structure, fourteen to roots, sixteen to the stem, and fourteen to the leaf. Elementary science, general science, and biology teachers will find this a most useful bulletin. —C.M.P.

CHAPMAN, WENDELL AND LUCIE. "Lords of the Rockies." *The National Geographic Magazine* 76:87–128; July, 1939.

This article describes and relates much interesting information regarding animal life in the Rockies. There are 42 illustrations, 28 of which are natural color photographs.

—C.M.P.

CLEMENTS, E. S. AND F. E. "Flower Pageant of the Midwest." *The National Geographic Society* 76:219–271; August, 1939.

This article describes flowers found in the Middle West. There are paintings and biographies of 125 flowers by Edith S. Clements.

—C.M.P.

CAHALANE, VICTOR H. "Deer of the World." *The National Georgraphic Magazine* 76:463–511; October, 1939.

This is a most interesting article on deer. There are 20 illustrations and 23 paintings in color by Walter H. Weber.

—C.M.P.

RENNER, GEORGE T. "Teaching Conservation of Resources." *The Journal of Geography* 38:245–251; September, 1939.

All levels of education should have a vital part in conservation education. The author lists seven things that should be stressed. A list of eight objectives in conservation are listed. Programs for various educational levels are briefly discussed.

—C.M.P.

STAPLE, FLORA M. "A Method of Teaching Daily Time Adjustment to Earth Rotation." *The Journal of Geography* 38:239–244; September, 1939.

The following concepts are developed through a series of lessons: (1) Concept of the meridian, (2) Concept of the solar hour and the twenty-four hour day, and (3) the concept of standard time.

—C.M.P.

HERMANNI, EDWIN G. AND RITCHIE, HAROLD S. "The Earth." *The Grade Teacher* 57:58–59, 86–87; September, 1939.

This is a work sheet for a unit in elementary science intended for the grammar grades. There are a series of questions, exercises, and review questions. A key to the questions is supplied.

—C.M.P.

ANONYMOUS "How Wild Birds and Animals Obtain Food." *The Grade Teacher* 57:14–15; September, 1939.

This illustrated article on elementary science is adaptable for all grades. Sections are devoted to discussion, technical words, questions, and class activities.

—C.M.P.

RANKIN, MARY I. "A Device for Teaching the Sun, Shadows, and Seasons." *The Journal of Geography* 38:276–278; October, 1939.

This is a teaching unit organized for the fourth grade.

—C.M.P.

SYMPOSIUM. "Community Planning." *Building America* 5:34–63; November, 1939.

This issue of *Building America* points out that at first communities were planned, but later they just grew. Our cities show their haphazard growth. The elements of community planning are: (1) business, industry, and transportation, (2) housing, (3) outdoor recreation, safety, sanitation, and (4) cultural recreation and education.

—C.M.P.

MEIGHEN, MARY. "Training Children to Use Their Geography Textbooks Efficiently." *The Journal of Geography* 38:330–332; November, 1939.

The skills that may be developed in problem solving, gathering, interpreting, and evaluating data by using geography textbooks are described by the author. These same techniques may be used in science.

—C.M.P.

HERMANNI, EDWIN G. AND RITCHIE, HAROLD S. "Longitude and Time." *The Grade Teacher* 57:53, 63; November, 1939.

This is an illustrated unit for the intermediate grades showing the relation of longitude to time. Maps showing the international date line and the standard time zones in the United States are included.

—C.M.P.

STEVENS, MARION PAYNE. "Desert Life." *The Instructor* 49:47, 56; November, 1939.

This is an illustrated unit providing teaching materials for the primary, middle, and upper grades. The unit includes objectives, method, possible approaches, activities for each grade, and pupil and teacher references.

—C.M.P.

HERR, SELMA E. "A Unit on Lighting." *The Instructor* 49:24, 78, 79; November, 1939.

This is an illustrated science unit for the upper elementary grades. Objectives, possible approaches, subject matter, and questions are included.

—C.M.P.

SYMPOSIUM. "Advertising." *Building America* 5:66–94; December, 1939.

Illustrated with numerous photographs, this number of *Building America* discusses the following questions: (1) How did Americans advertise in the past? (2) What are the methods of modern advertising? (3) How does advertising affect us? (4) What groups are trying to change some of the present advertising methods? and (5) In the word battles over advertising, what are the claims of each side and what is being done about them?

—C.M.P.

GOULD, GERTRUDE. "The Stars." *The Grade Teacher* 57:38, 69, 73; December, 1939.

This is an illustrated unit in elementary science, intended for the upper grades.

—C.M.P.

HERMANNI, EDWIN G. AND RITCHIE, HAROLD S. "Earth's Neighbors." *The Grade Teacher* 57:52–53, 81; December, 1939.

This is an illustrated unit intended for the upper grammar grades. Most of the unit consists

of a series of questions to be answered by the pupils.

—C.M.P.

THOMAS, KATHERINE. "The World's Forests." *The Instructor* 49: 59, 72; December, 1939.

This is an elementary science unit intended for the upper grades. The unit seems to be fairly complete and quite practical.

—C.M.P.

CALDWELL, EVA LEE. "A Unit on Milk." *The Instructor*, 49: 49, 68; December, 1939.

This is a unit in elementary science intended for the primary grades.

—C.M.P.

SYMPOSIUM. "Arts and the American Craftsman." *Building America* 5: 98–128; January, 1940.

This illustrated issue discusses the following problems: (1) How did original design develop in America? (2) What materials were used? (3) How did the machine affect American design at first (4) How does modern industry try to combine art with machine perfection? and (5) Can the handicrafts take an important place again in Modern America?

—C.M.P.

BRINK, IDA K. "Science Excursions in Winter." *The Instructor* 49: 25, 68; January, 1940.

This article describes six types of possible science excursions in elementary science. The time factor and need of planning for such excursions are emphasized.

—C.M.P.

EASTWOOD, FLORENCE. "The Seasons." *The Grade Teacher* 57: 24, 73; February, 1940.

This is an elementary science unit intended for the primary grades. Objectives, outcomes, reading, tests, and activities are included.

—C.M.P.

HERMANNI, EDWIN G. AND RITCHIE, HAROLD S. "Winds." *The Grade Teacher* 57: 48, 73; February, 1940.

This grammar grade unit on weather includes weather lore, test, effects of wind, and facts to be remembered.

—C.M.P.

SECONDARY SCIENCE

EIKENBERRY, W. L. "Science as an Adventure." *The Science Counselor* 5: 45–46; June, 1939.

The author maintains the thesis that man is ever a venturesome animal. This is exemplified in his early childhood and in earlier times was carried to fruition by exploration, and later by going west. Since there is no longer a frontier for venturesome youth, science would seem to offer an excellent outlet for this most desirable trait.

—C.M.P.

SIMMONS, MAITLAND P. "Changing Conceptions in the Relative Sequence of Major Topics in General Science Textbooks (1911–1934)." *Reprint from the Journal of Experimental Education*, June, 1939.

Sixteen textbooks were analyzed. The writer found a distinct lack of sequence of topics. The sequence of topics seems to vary in accordance with the ideas of the authors writing the books. Various units are discussed as to their placement.

—C.M.P.

SIMMONS, MAITLAND P. "Science for Leisure Time." *Reprint from School Science and Mathematics*, October, 1939.

The author discusses the values of having pupils of special aptitudes make projects relative to the lesson unit. Suggested projects with references are listed for the following units: (1) air, (2) the earth's crust, (3) forces of nature, (4) the universe, (5) light, (6) transportation, (7) electricity, and (8) animal life.

—C.M.P.

SYMPOSIUM. "Selecting Science Textbooks." *The Science Counselor* 5: 29–34, 60; June, 1939.

Problems, and the pro's and con's of textbook selection in the various fields of science are presented in following articles:

Choosing a General Science Textbook by Franklin B. Carroll.

What Physics Text Best Suits Your Course by Herman M. Campsen, Jr.

Criteria of a High School Biology Text by Leo J. Fitzpatrick.

Choosing Chemistry Textbooks in Pittsburgh by J. C. Amon.

—C.M.P.

SYMPOSIUM. "Progressive Practices in Secondary Schools." *The High School Journal* 22: 257–297; November, 1939.

The reviewer chooses to discuss the articles in this issue of *The High School Journal* as a unit rather than to review separate articles. By considering this issue as a whole, one becomes strikingly aware of the direction of modern secondary education. Any high school teacher, regardless of his subject specialization, should gain a better understanding of the relation of his teaching to the whole program through reading the articles in this issue.

—O. E. Underhill.

ANONYMOUS "United States Leads World in Chemistry." *Science News Letter* 36: 125; August 19, 1939.

The United States now leads the world in chemistry, with Great Britain, second, and Germany, third.

—C.M.P.

New Publications

NOLL, VICTOR H. *The Teaching of Science in Elementary and Secondary Schools.* New York: Longmans, Green and Company, 1939. 238 p. $2.50.

The title of this book is indicative of its content and purpose. The book will be found useful both as a text for college and university classes in the teaching of science and as a handbook for teachers in service.

Major divisions deal with the objectives of science teaching, the teaching of scientific attitudes, the selection of methods for science teaching, curricular materials for elementary schools, junior high schools, and senior high schools, the measurement of achievement in science, and with the qualifications of science teachers.

Particularly significant chapters are those on scientific attitudes and the measurement of achievement in science. Bibliographies at the ends of units are particularly well selected and useful.

The book is recommended for personal library purchase by science teachers and for consideration as a text by teachers of courses in the teaching of science.

—R.K.W.

MEISTER, MORRIS. *Air and Water; Food and Sunshine; Life and the Weather; Man and His Neighbors; The Needs of Living Things; and Life and Energy.* New York: Charles Scribner's Sons, 1939. 190 p., 182 p., 190 p., 206 p., 375 p. and 391 p. $0.88; $0.88; $0.88; $0.92; $1.28 and $1.32.

This is a *Living With Science* series of general science textbooks for the seventh, eighth, and ninth grades. The first two named are for the seventh grade, the second two for the eighth grade, and the last two for the ninth grade. The seventh and eighth grade books are bound as single volumes for each of those grades.

The author, Principal of the Bronx High School of Science, has always been a firm believer in science club work and numerous, well-planned demonstrations in science. With this belief, the author's textbooks have an abundant supply of things for pupils to do and make—demonstrations, home experiments, and science club activities.

Each unit is introduced with a science "story" and closes with a page of problem pictures. Each unit has a review test entitled "How Much Do I Remember." Toward the close of each unit is a series of paragraphs of things to read about and think about. There are an abundance of excellent, pertinent pictures. If an abundance of suggested demonstrations, pupil activities, and teaching aids is one criterion of a teachable book, this series is one of the very best. General science teachers will find this not only excellent as the main textbook, but also very helpful as a supplementary text to the one now being used.

The above series is also available in a three-book series—Book I *Air and Water* and *Food and Sunshine* at $1.40; Book II *Life and the Weather* and *Man and His Neighbors* at $1.44 and Book III *The Needs of Living Things* and *Life and Energy* at $1.80.

—C.M.P.

BEAUCHAMP, WILBUR L., MELROSE, MARY, AND BLOUGH, GLENN O. *Discovering Our World, Book Three.* Chicago: Scott, Foresman and Company, 1939. 464 p. $1.00.

Discovering Our World, Book Three completes the middle grade science program. (Other volumes in the series have been reviewed previously.) This book continues the same pattern of the two that have preceded it, the development of science concepts at a little higher level (the sixth grade) to fit the needs, interests, and abilities of older pupils. The general plan is to make the child observe and experiment and think for himself. He is taught to approach problems in the spirit of inquiry and research and to look for cause-and-effect relationships.

The style is informal and reading difficulties have been paid particular attention. The book is replete with excellent photographs, thought-provoking questions, and numerous learning techniques.

There are ten units as follows: (1) How do living things behave? (2) How have living things developed on earth? (3) What makes sound? (4) How do we use electricity? (5) How do we control fire? (6) How do we use light? (7) What is the universe like? (8) How can we keep well? (9) How does man take care of living things? and (10) How can we conserve the materials and living things of the earth?

—C.M.P.

HEISS, ELWOOD D., OBOURN, ELLSWORTH S., AND HOFFMAN, C. WESLEY. *Modern Methods and Materials for Teaching Science.* New York: The Macmillan Company, 1940. 351 p. $2.50.

The science teacher in service will want to own a copy of this newest of the books on the teaching of science in secondary schools. The many practical helps included will make this book a constant work-table companion for the alert and progressive teacher.

The content of the book is arranged in three major divisions. The first carries the usual pedagogical treatment of the teaching of science. This begins with the philosophy of the teaching of science, follows with the psychology, and then

adds the treatment of methods of science teaching and a consideration of the means of evaluation of the results. Much of this material is drawn from recent publications of the Progressive Education Association on the teaching of science and its evaluation.

The second division deals with various visual aids, including the school journey. There are separate chapters on photography, objects and models, the microscope, the telescope, and upon projection machines and equipment. Each type of equipment is clearly described and illustrated. Many suggestions for the purchase of equipment and its school uses are given.

Division three consists of lists and sources of teaching materials. These include flat pictures, commercial exhibits and specimens, charts and posters, and a long list of science films.

At the end is a classified list of science bibliographies and a list of publishers.

There is no treatment of science furniture nor of the usual laboratory equipment for science. It is to be hoped that the authors will continue the work which they have begun by revising and bringing their lists up to date as these ultimately become obsolete.

—R.K.W.

McCALL, WILLIAM A. *Measurement.* New York: The Macmillan Company, 1939. 535 p. $4.00.

One of the best known books in education has been McCall's *How To Measure in Education.* While this new book *Measurement* is listed as a revision of the first named, it seems to the reviewer that *Measurement* is in actuality a new book. Certainly it comes nearer to being a new book than do many books written by the same author in the same general field. *Measurement* is a real compendium of knowledge in philosophy, psychology, tests and measurement, and evaluation. The author's philosophy of measurement is the finest treatise that the reviewer has ever read. It is indeed regretable that so few classroom teachers will ever read it.

The major divisions of the book are: (1) place of measurement in education, (2) criteria for the selection and construction of standard and teacher-made tests, (3) use of standard tests for grouping pupils, (4) program of measurement for progressive schools, (5) guidance and evaluation of teaching by measurement, (6) school marks and reports, (7) presentation of test results and (8) how to scale tests and present results.

The book includes a comprehensive list of all available tests.

Altogether this monumental work well serves as a capstone to the writings of one of America's greatest teachers.

—C.M.P.

DONOVAN, FRANCES R. *The School Ma'am.* New York: Frederick A. Stokes Company, 1938, 355 p. $2.50.

This is a complete, non-technical survey of the field of teaching—a picture of the lives, problems and trends of today's educators. This book is not a textbook in the usual sense of the term, but there are few, if any, professional courses in teacher training, in which this book would not be a most appropriate supplementary reading book.

Curiously enough, there are really few desirable supplementary books for courses in education. Most of the so-called supplementary textbooks are really textbooks or could well be used as such. There are few popular, supplementary books as we have them in the field of science.

The reviewer thoroughly enjoyed this book. You will, too, if you are a teacher or a prospective teacher. Here is a lively, entertaining book portraying teachers as human beings with all their virtues, aspirations, faults and shortcomings, who are really the dynamos of the teaching profession (as they are far in the majority in the elementary grades) but it is a fine book for all teachers.

Chapter headings are as follows: (1) her numerical superiority, (2) her infinite variety, (3) why she is unmarried, (4) one of the unmarried, (5) the married teacher, (6) the case of Hope Gray, (7) the queer teacher, (8) one of the widowed, (9) the pupil looks at the teacher, (10) who she is and why she teaches, (11) her training, selection and appointment, (12) school boards and superintendents, (13) teacher mobility, (14) her place in the community, (15) her private life, (16) her economic position, (17) her tenure, pension, and old age, (18) to be or not to be—a school ma'am, (19) teaching as a career, (20) her professional organization, and (21) the school ma'am of tomorrow.

—C.M.P.

WENDT, GERALD. *Science for the World of Tomorrow.* New York: W. W. Norton and Company, 1939. 316 p. $2.75.

The outstanding achievement of man has been the use of his intelligence to improve the environment of the human race. In this book the author reviews our civilization and seeks out those elements of life today which are to build the world of tomorrow. Hence the book is philosophical, analytical, and prophetic. To the author science is not merely a great body of knowledge, a vast encyclopedia of facts and principles, nor a great collection of useful instruments, of gadgets and machines. It is all that and more too. It is essentially a method of solving problems—human problems. Thus the author inquires what is this world of men, why do they live as they do, what does the future hold? No program or panacea for society is offered. But the author looks hopefully forward to a better future world for every man if man will only use his intelligence to make it so. In this decision lies the future fate of man.

Dr. Wendt emphasizes the inestimable effect of our environment upon us—upon our minds and hearts and customs. The science of the future will not only provide us with material things more or less sporadically as at present, but also to the enrichment of life in all its aspects.

The author is Director of Science of the New York World's Fair, a research scientist of note and formerly Associate Professor at the University of Chicago, Dean of the School of Chemistry and Physics at Pennsylvania State College, and for twelve years Editor of *Chemical Reviews*.

The reviewer enjoyed particularly the philosophical and prophetic aspects of the treatise. Undoubtedly it is one of the best popularizations in science in some time. It is recommended not only for all educated laymen, and for supplementary reading in senior high school and college survey courses, but also to all elementary science, junior high school, senior high, and college science survey instructors.

—C.M.P.

Williams, Alice Marietta. *Children's Choices in Science Books.* New York: Bureau of Publications, Teachers College, Columbia University, 1939. 163 p. $1.85.

After deciding upon what seemed to be the most advantageous method of determining the real choice of children in science books, the author first made a study of the circulation of science books in nine different children's libraries, comparing the books having high and low circulation. The second step was to study children's reactions to thirty-five selected science books having high, medium, and low circulation. As a third part of the study, personal interviews were held with each child cooperating in the study. Also a study was made of the published book reviews, and also of the reactions of adults to the thirty-five books.

Some of the conclusions from this investigation: (1) Some science books circulate much more frequently than others, (2) Books in which the content was presented in a direct manner circulated more frequently than books in which the essay type of approach was used, (3) Factual books circulated more frequently than narratives, (4) Books containing personification circulated usually a little less frequently than books not employing this device, (5) Books in which illustrations are an integral part of the book circulate more frequently than books in which illustrations were purely decorative, (6) Books with many illustrations circulate more widely than do books with few illustrations, (7) Books with colored illustrations and books with photographic illustrations circulate more frequently than books with half-tone illustrations, block prints, or line drawings, and (8) A larger per cent of the books in the field of aviation, astronomy, physics, and chemistry had a higher circulation than books in other fields of science. These observations on circulation were confirmed from the overt and verbal responses of the children. There was a very high degree of consistency between overt reactions of the children to the thirty-five books used in the study and their remarks concerning these books in the interviews.

—C.M.P.

Garrison, Charlotte G. *Science Experiences for Little Children.* New York: Charles Scribner's Sons, 1939. 111 p. $1.50.

The author has been an instructor in the Kindergarten-First Grade of the Horace Mann Elementary School of Teachers College for more than twenty-five years. With this experience as a background, the author presents science experiences appropriate for various grade levels. However, most of the material is appropriate for the primary grades.

There is an introduction by Patty Smith Hill, well-known leader in elementary education. The following major points are considered: (1) the place of the school and the home in providing science experiences for young children, (2) experiences with animals, (3) experiences with plant life, (4) experiences with forces of nature, and (5) bibliography.

Elementary science teachers will find in this book many science activities that would greatly vitalize their science teaching.

—C.M.P.

Hale, Florence. *Nature Lore.* Darien, Connecticut: Educational Publishing Company, 1939. 80 p. Paper cover.

This book, as its name implies, is a compilation of 200 stories in which curious and unusual occurrences in lives of animals and plants are related in a more or less fanciful manner. It is illustrated by 150 pictures in black and white.

—F.G.B.

Gordon, Eva L. *A Bibliography of Nature Study.* Ithaca: Comstock Publishing Company, 1939. 45 p. $0.25.

This is reprinted from Twenty-fourth Edition of Comstock's *Handbook of Nature Study* (previously reviewed in Science Education). It is an annotated bibliography, divided into the following sections: (1) General Information and Stories, (2) Essays and Travel, (3) Poetry, (4) History and Biography, (5) Textbooks and Readers, (6) Magazines and Periodicals, (7) Animals in General, (8) Mammals, (9) Birds, (10) Reptiles, Amphibians, and Fish, (11) Insects and Other Invertebrates, (12) Plants in General, (13) Wild Flowers and Weeds, (14) Flowerless Plants, (15) Garden Flowers and Cultivated Crop Plants, (16) Trees, Shrubs and Woody Vines, (17) The Earth and Its Life, (18) Weather and Climate, and (19) Stars and Sky.

—C.M.P.

Hudspeth, Jack, and Hudspeth, Frances H. *Elementary Science Book 4; Teachers' Manual for Elementary Science Book 4; Science Book 7 and Teachers' Manual for Science Book 7.* Austin, Texas: The Steck Company, 1939. 96 p., 60 p., 120 p., and 80 p. $0.35 each.

The above series of two books are intended for grades four and seven. (Books for grades three, five and six have been reviewed previously in

SCIENCE EDUCATION. Book two will soon be available.)

Altogether the series promotes a well-rounded elementary science program. The approach is somewhat along the line of individual pupil work-and-study books so common in the upper levels. Duplication of material from one grade level to another has been kept to a minimum. The Teachers' Manual offers many suggestions for class, group and individual activities. Unit Tests may be had for each grade. Whatever the classroom procedures may be, most elementary science teachers will find here many useful suggestions and much practical advice.

Units for Book 4 are: (1) Insect life, (2) Water and its uses, (3) Getting ready for winter, (4) Using fire usefully and carefully, (5) Being healthy by being wise, (6) Our changing earth, (7) Water life, and (8) The earth's neighbors. Units for Book 7 are: (1) Figuring things out, (2) Our world of living things, (3) Modern living, (4) Going places, (5) Changing temperatures, (6) Healthful living, (7) The story of the earth, (8) Living safely, (9) Our sources of energy, and (10) The battle for life.

—C.M.P.

FEDERAL WRITERS' PROJECT. *The Ladder of the Clouds; The Book of Stones; Snow, Glaciers, and Icebergs; A Trip on Many Waters; The Story of Bees;* and *Looking at the Moon.* Chicago: Albert Whitman and Company, 1939 and 1940. 44 p., 33 p., 43 p., 48 p., 45 p., and 48 p. $0.50 each.

The above are the titles of the first six books in a thirty-book Children's Science Series, compiled and written by the Federal Writers' Project, Work Projects Administration of the Commonwealth of Pennsylvania.

Each book is printed in large type, is fully illustrated, and the material has been checked for accuracy by well-known authorities in the particular field. The vocabulary is about third or fourth grade in difficulty.

The entire series of small booklets will constitute a well-rounded-out series of appealing supplementary science readers covering a wide range of topics.

—C.M.P.

STAFF OF THE FEDERAL WRITERS' PROJECT, WORKS PROGRESS ADMINISTRATION, IN THE CITY OF NEW YORK. *Reptiles and Amphibians.* Chicago: Albert Whitman and Company, 1939. 253 p. $2.25.

This is the third book of the Federal Writers' natural history series. (Other books in this series are *Who's Who in the Zoo* and *Birds of the World.*) It is a collection of brief biographies that include the natural history of many reptiles and amphibians found in various parts of the world. The stories are written in simple, straightforward, interesting style that will attract anyone of junior high school age or older who is curious about reptiles and amphibians. The book is written in non-technical language. The manuscript has been read and checked for scientific accuracy by two well-known authorities in the field, Dr. Raymond L. Ditmars and Clifford H. Pope.

The book is beautifully and profusely illustrated by 129 excellent candid-camera photographs, nine descriptive charts, and a map showing world distribution of reptiles and amphibians. All illustrations are in black and white.

—F.G.B.

PETERSHAM, MAUD AND MISKA. *The Story Book of Things We Wear.* Philadelphia: The John C. Winston Company, 1939. 128 p. $2.50.

Here is another excellent book by the well known Petershams. It is the romantic legends and true stories of four important materials used for clothing—cotton, wool, silk, and rayon. The stories are simply written and fascinating in themselves. They give a vast amount of information and will make anyone more appreciative of the clothing they wear. The books may well be used in the intermediate grades or lower junior high school. They are excellent supplementary books for science units. There are numerous illustrations, half of them in six colors.

The stories may be obtained also in separate volumes, if desired. Price, seventy-five cents for each title.

—C.M.P.

SCHMIDT, KARL PATTERSON. *Our Friendly Animals and Whence They Came.* Chicago: M. A. Donohue and Company, 1938. 64 p. $1.50.

This is the story of the origin from their wild ancestors of some of our common domesticated animals, such as dogs, cats, cattle, sheep, goats, horses, donkeys, and swine. It is told in an interesting, authoritative, straight-forward manner by a trained naturalist who is assistant curator of reptiles in the Field Museum of Natural History.

The charm of the book is enhanced by twelve beautiful full-page colored plates made from paintings by Walter Alois Weber, the well known animal painter. The margins of each page and the fly leaves are attractively and appropriately illustrated by realistic drawings of animals.

This delightful and instructive book will be enjoyed by secondary school students and adults. It should have a place in every secondary school and public library.

—F.G.B.

MCINTIRE, ALTA. *Butterflies and Moths.* Chicago: Follett Publishing Company, 1938. 40 p. $0.45.

This little book gives interesting information about the life habits of common moths and butterflies. The excellent photographs, many of which are full page illustrations, make it a real picture-story. At the close of each section in the book are exercises designed to help the young reader test himself on what he has read. Children of fourth and fifth grade levels will be interested in this book. —F.G.B.

BRONSON, WILFRID S. *The Chisel-Tooth Tribe.* New York: Harcourt, Brace and Company, 1939. 200 p. $2.00.

You will find this account of our chisel-tooth friend and foe entertaining and instructive from start to finish. It gives delightful word and pen pictures of the homes, habits, and life of the great army of small mammals which include squirrels, chipmunks, prairie dogs, woodchucks, beavers, rats, mice, porcupines, hares, and rabbits. The book has fine black and white and colored pictures by the author.

—W.G.W.

BRANSON, PAUL. *Animals of American History.* New York: Frederick A. Stokes, 1939. 50 p. $2.00.

This is an unusual combination of natural and social history and should be a welcome addition to every elementary school library. Although designed and presented as "A Picture Book" featuring the artist, the pictures and text so complement each other that either without the other would seem vitally lacking. The text is by Helen Dean Fish. Accurate and interesting information is given about various animals, together with something of the background of early American history of which they formed a part. Some are discussed individually as wild horse, wild turkey, woodchuck, and wolf. Others are grouped under such heads as Wilderness Animals known by Daniel Boone and his Followers, Rocky Mountain Animals Found by the Lewis and Clark Explorers, Arctic Animals Found by Peary's Expeditions to the Pole.

—O. E. Underhill.

MORGAN, ANN HAVEN. *Field Book of Animals in Winter.* New York: G. P. Putnam's Sons, 1939. 527 p. $3.50.

This book follows various animals through the winter—what they eat, where they live, and what they do. This guide should prove most useful to those out of school as well as those in school. It is an excellent book for elementary science, general science, and biology teachers, as well as for the science book shelf.

There are figures of nearly all of the animals discussed, 283 line drawings, photographs, and 4 full color-plates.

The author is Professor of Zoology at Mount Holyoke College.

—C.M.P.

HOWARD, ETHEL K. *How We Get Our Food.* New York: Harcourt, Brace and Company, 1939. 111 p. $0.88.

This is a book intended for the third grade. The vocabulary has been checked against the Thorndike Word List, the International Kindergarten Union List, the Horn List, the Gates List, and the Free Association List.

There are six units, each of which deals with basic foods essential to a child's diet. The six units are: (1) How We Get Our Milk, (2) How We Get Our Meat, (3) How We Get Our Bread, (4) How We Get Our Fruit, (5) How We Get Our Vegetables, and (6) How We Get Our Poultry. There are 56 half-page photographs and 25 whole page photographs. These photographs are of excellent quality.

There is a separate Teacher's Manual that may be obtained upon request. The author is supervisor of elementary instruction at Lakewood, Ohio. This is an excellent supplementary reader for all grade science classes.

—C.M.P.

MEDSGER, OLIVER PERRY. *Edible Wild Plants.* New York: The Macmillan Company, 1939. 323 p. $3.50.

For a long time there has been a great lack of information on edible wild plants. The pioneers of two or three centuries back depended on many of these fruits, nuts, herbs, etc., for food; but as cultivated foods began to take their place, knowledge of what is poisonous, what is barely edible, and what is both nourishing and delicious, was gradually lost. Thus this book serves a most useful purpose—the first complete handbook of America's wild menu. Almost every edible plant growing outside of cultivation is described in detail. Described with precision and imagination are 69 species of edible fruits and berries, 26 salad plants and potherbs, 19 roots and tubers, 13 beverage and flavoring plants, and 10 seed and seed-pods. Great numbers of other edible but less known plants are listed with brief descriptions.

Professor Medsger, well-known for his work in Nature Education at Pennsylvania State College, has personally tried out almost every variety of plant which he includes. He not only enumerates names and characteristics, but also tells how to prepare or cook such plants as require cooking. Interspersed with interesting comment, the book forms not only an excellent compendium of knowledge, but also entertaining reading. A combined index of scientific and common names, and a seasonal, geographical, descriptive key makes a most complete, useful book. The book is recommended for the general science and biology book shelf. Elementary science, general science and biology teachers, as well as many laymen, will find the book quite useful.

—C.M.P.

VERRILL, A. HYATT. *Wonder Plants and Plant Wonders.* New York: D. Appleton-Century Company, 1939. 226 p. $3.00.

This book is another evidence of Mr. Verrill's ability to write unusually interesting books on science subjects. A number of these books have previously been reviewed in SCIENCE EDUCATION. *Wonder Plants and Plant Wonders* is packed full of curious, fascinating stories of the strange and wonderful things that occur in the plant world. Not only does the author describe the marvels of plant life in distant jungles but also unusual plants close at hand.

Some of the chapter headings are: (1) The

plant department store, (2) the most useful trees, (3) Trees that grow while you wait, (4) Plants that cure and kill, (5) Plant giants, (6) Intelligent plants, (7) Strange partners, (8) Magic plants, (9) Plants with strange uses, (10) Plant public enemies, (11) The first of all calendars, and (12) The most wonderful plants.

The reviewer recommends this book for the high school science book shelf. It is especially recommended as a supplementary reading and reference book in biology. Teachers of biology, general science, and elementary science will enjoy reading this book. —C.M.P.

COFFMAN, RAMON PEYTON. *The Child's Story of Science.* New York: G. P. Putnam's Sons. 242 p. $2.50.

The author of this book is the "Uncle Ray" familiar to many children through his feature stories which appear in many newspapers, throughout the country. The material is based on the most popular of his articles and covers a wide range. The first four chapters deal with astronomy; then follow chapters on atmosphere, geology, prehistoric animals and plants, various animals, and some topics from the fields of physics and chemistry, twenty-seven in all. The information is interesting but specific, and accurate.

—O. E. Underhill.

BARRETT, CHARLES. *Koonwarra.* New York: Oxford University Press, 1939. 315 p. $3.00.

Koonwarra—the aboriginal word for "Black Swan"—is not just a story about the black swan but is an account of a master naturalist's adventures in Australia. There are stories and pictures of flowers, ferns, animals of many kinds, of native and other people. Their experiences are interesting and enlightening. The fifty half-tone illustrations from photographs by the author are not only rare pictures but of a quality showing his great skill as a photographer.

—W.G.W.

JAQUES, FLORENCE P. *The Geese Fly High.* Minneapolis: University Minnesota Press, 1939. 102 p. $3.00.

The nature lover will find that Mr. and Mrs. Jaques have written a delightful and absorbing story of their unique 2-month winter vacation traversing a 4000-mile great circle—the route of the ducks and geese. From the marshes of Minnesota through cypress swamps of Arkansas down through Mississippi and into the heart of the coastal marshes of Louisiana, they made their journey with much physical discomfort at times but always with a rich reward for the effort. This is a rare view of wilds that few visit and you will enjoy reading their complete story.

—W.G.W.

HUNTINGTON, HARRIET E. *Let's Go Outdoors.* New York: Doubleday, Doran and Company, 1939. 88 p. $2.00.

An excellent early reading book about snails, turtles, ants, bees, worms, frogs, toads, butterflies, sow bugs, ladybird beetles and dragon flies. In fact it can be read to children of pre-reading age. The full page illustrative photographs are excellent; a number of them "big pictures." These magnified photographs of head of a fly, and of dragon fly are unusually fine. The text is accurate and straightforward.

—O. E. Underhill.

LINCOLN, FREDERICK. *The Migration of American Birds.* New York: Doubleday, Doran and Company, Inc., 1939. 189 p. $4.00.

This is one of the series of books in the Nature Library. That it was written by Dr. Lincoln, senior biologist of the United States Department of Agriculture, who has devoted thirty years to the study of bird movements, is evidence of its authority. The work treats: origin of migration, mechanics of migration, influence of weather, dangers of and time of migration, distances covered, palagric and vagrant migration, bird banding, evolution of migration routes, four flyway systems. There are twelve colored plates from paintings by Louis Agassiz Fuertes and twenty-two maps.

—W.G.W.

COEVERING, JACK VAN. *Real Boys and Girls Go Birding.* Philadelphia: J. B. Lippincott and Company, 1939. 151 p. $2.00.

This attractive book contains short stories of trips and observations of the author with children. The stories are certain to interest children of the middle elementary grades. The book is well illustrated with unusually fine photographs.

—W.G.W.

BAER, MARIAN E. *Pandora's Box. The Story of Conservation.* New York: Farrar and Rinehart, Inc., 1939. 292 p. $2.00.

When the first settlers came to this country, they found a veritable paradise of natural resources. With the increase in population and the westward movement, forests were cut down, swamps were drained, and in many cases, more than the normal yearly increase in wild life was destroyed. Gradually, the tendency to a balance in nature was destroyed and resulted in a new frontier, a frontier of conservation in which we as pioneers are charged with the task of finding ways of compensating for past disturbances. It is, then, the problem of the present pioneers to find ways and means of saving for themselves and for future generations what is left of our natural resources.

Pandora's Box offers many stimulating suggestions for wise use and conservation of our present natural resources. It is a story of conservation of rich top soil, great forest areas on watersheds, mineral resources, and wild life in streams, fields, sea coasts, and forests. It is written in a simple informative manner for boys and girls of junior high school age and is of interest to adults as well. —F.G.B.

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